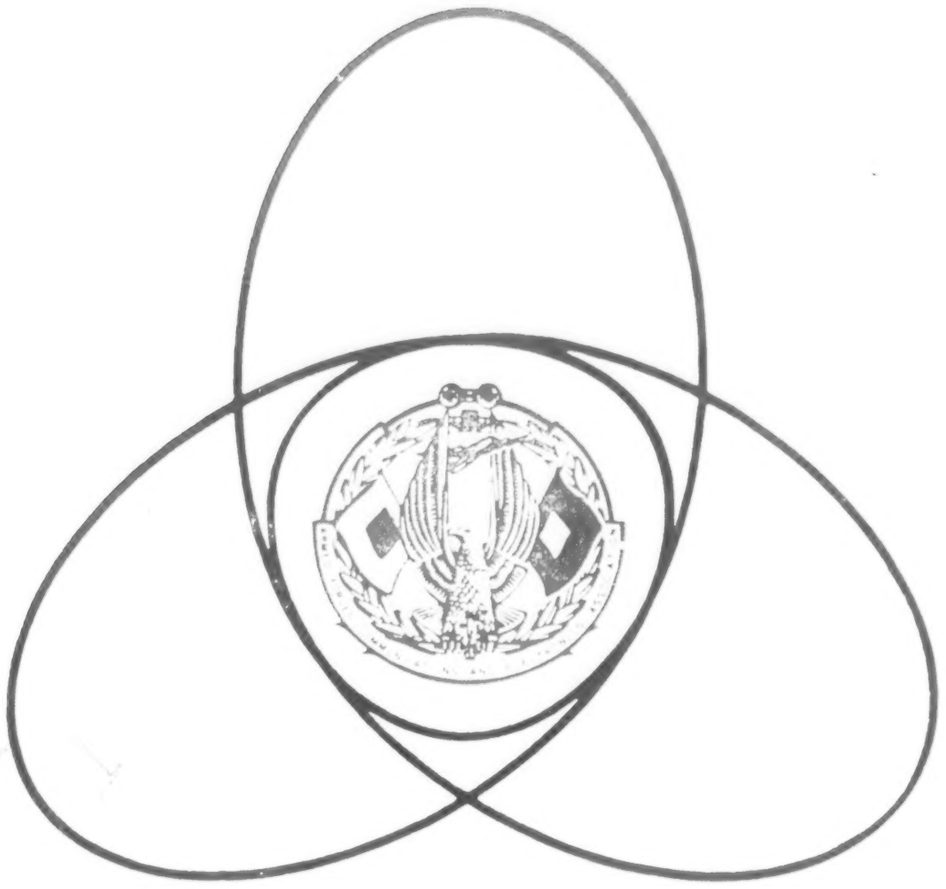
May 1960

SIGNAL



COMMUNICATIONS
ELECTRONICS
PHOTOGRAPHY

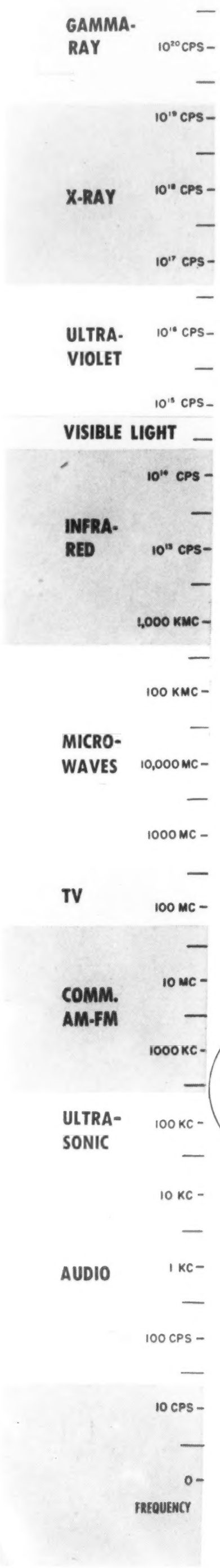
The Arm of Control · The Voice of Command

14th

FOURTEENTH ANNUAL
AFCEA CONVENTION ISSUE

SHERATON-PARK HOTEL
WASHINGTON, D. C.

MAY 24-25-26, 1960



"...working in the 90-220 kmc frequency ranges?"

- *Crystal, Bolometer, and Thermistor Mounts.*
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- *Slotted Sections.*
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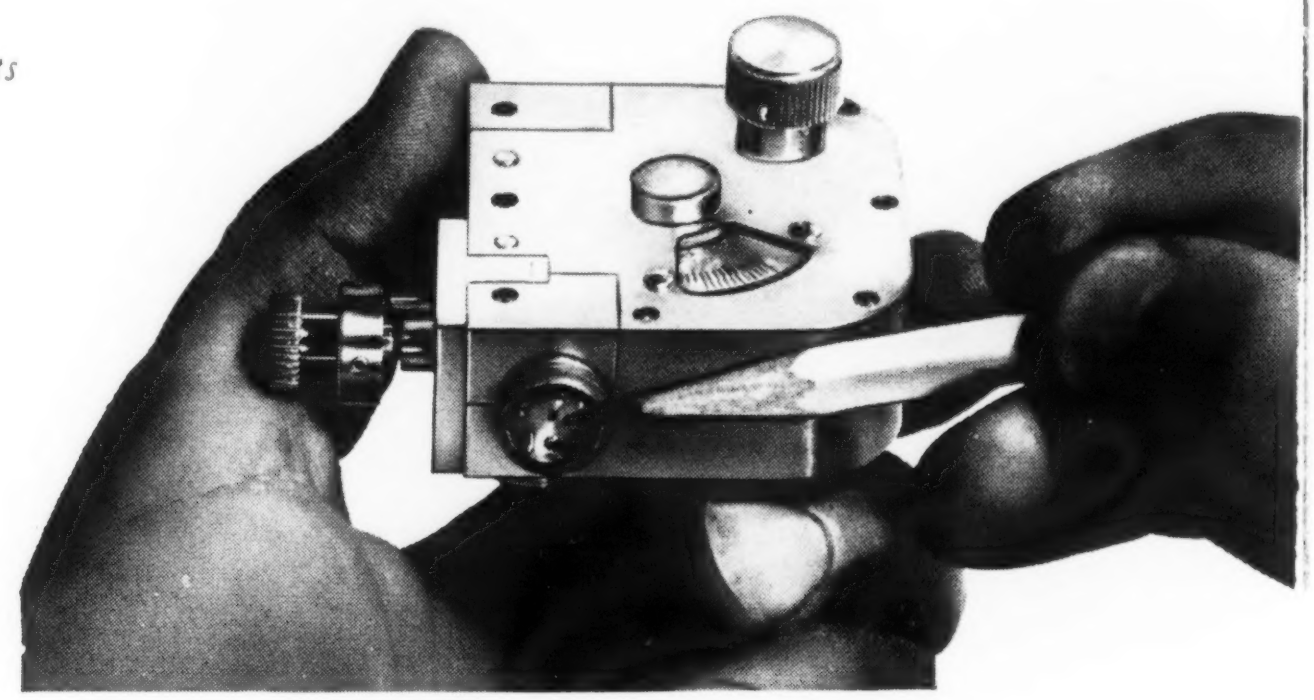
- *E/H Tuners.*

Other components shown below.

Slotted section, shown here, actual size.



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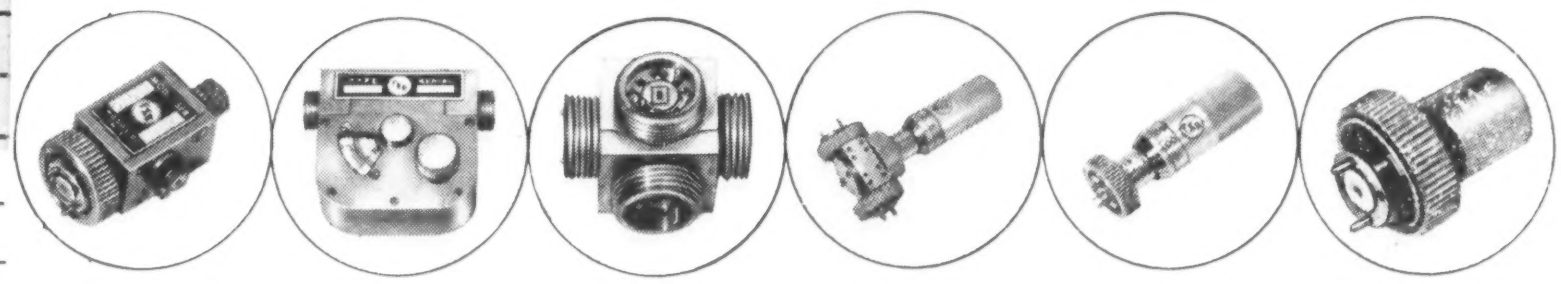

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View of the city of San Juan, Puerto Rico

NEW UNDERSEA TELEPHONE CABLE TO PUERTO RICO AIDS DEFENSE

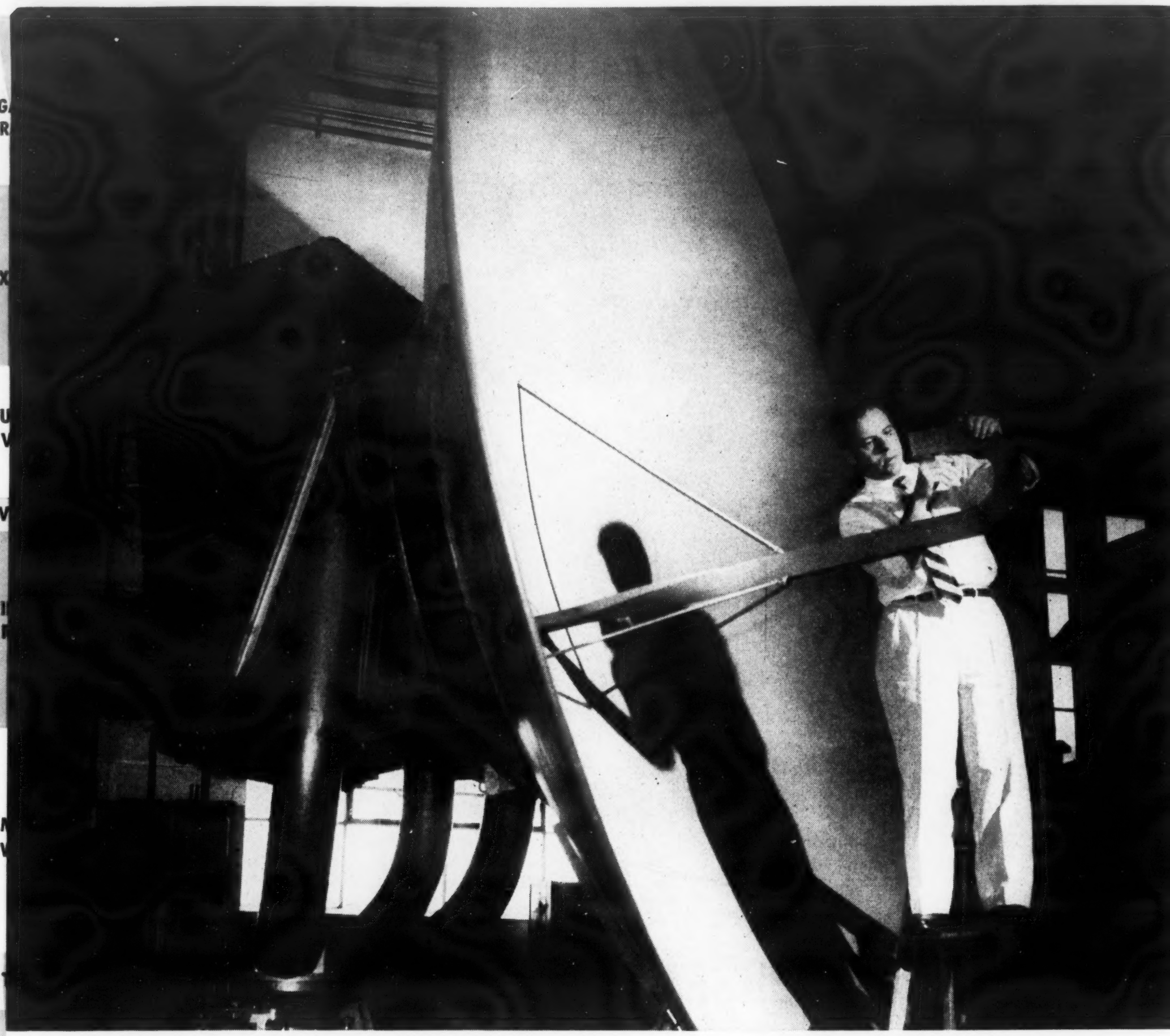
In addition to its social and business usefulness, the new submarine telephone cable opened recently to Puerto Rico benefits the nation's defense efforts as well.

For it provides a dependable communications link for military and civilian use between the mainland and an important territory.

This new cable is the deepest telephone cable in the world, at one point dropping to a depth of five miles below the ocean's surface. The cable project was undertaken jointly by the Long Lines Department of American Telephone and Telegraph Company and the Radio Corporation of Puerto Rico, a subsidiary of International Telephone & Telegraph Corp.

The Puerto Rican telephone cable joins many others laid in the past few years—to Hawaii, Alaska, England and Europe—and provides another element of the world-wide communications network we are helping to develop for both civilian and military use.

BELL TELEPHONE SYSTEM



Twelve-foot diameter dish of WSR-57 "Stormfinder" radar. System operates at S band, has 250-mile range, 500 Kw output.

Now being delivered to the U. S. Weather Bureau are WSR-57 weather detection radars. Each unit covers 200,000 square miles, tracks storms, identifies rain, snow and fog. This equipment is designed and produced by Raytheon.

RAYTHEON COMPANY, WALTHAM, MASS.

RAYTHEON

EXCELLENCE IN ELECTRONICS

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BPA

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Journal of the Armed Forces Communications and Electronics Association

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WHY NOT JOIN AFCEA—See Application form on page 92

Stepping boldly across new thresholds, DECO pioneers in:

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Through this open door to previously unexplored frontiers, DECO proudly contributes to the nation's advancement in communications technology with these recent achievements: *Communications Moon Relay* (NAVY) . . . *Tapered Aperture Horn Antenna* (TAHA) (ARMY SIGNAL CORPS) . . . *VLF Radiation System* (NAVY), *World's Largest Transmitting Facility* . . . *World's Largest Radio Telescope* (PUERTO RICO) (CORNELL U.—AIR FORCE).

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LIVE CMR DISPLAY AT AFCEA CONVENTION—BOOTH #149

THE WHITE HOUSE
WASHINGTON

March 30, 1960

Mr. Benjamin H. Oliver, Jr.
President
Armed Forces Communications
and Electronics Association
1624 Eye Street, N. W.
Washington 6, D. C.

It is a pleasure to send greetings to those attending the Fourteenth Annual Convention of the Armed Forces Communications and Electronics Association.

This Association has done much to advance the peaceful and the military uses of communications and electronics resources. The theme of its annual convention, "Communications and Electronics -- The Arm of Control, The Voice of Command," has broad meaning for all who are concerned with the need for understanding among ourselves and among nations.

I am delighted to add my best wishes for a fine convention.

Dwight D. Eisenhower

DWIGHT D. EISENHOWER

B. H. OLIVER, JR.
National President, AFCEA
Vice President Upstate
New York Telephone Company

AFCEA President's Greeting

WE ARE indeed proud and happy to welcome you to our Fourteenth Annual Convention of AFCEA. Proud that what we do is a measurable contribution to the nation of which we are so fortunate to be citizens. Happy that so many companies, so many military men, and so many individuals join with us here in Washington during these three days and throughout the year to help accomplish the objectives of this Association.

Get acquainted with each other and with the many wonderful displays in the various Exhibit Halls. These exhibits afford an opportunity to look into the tomorrow of communications with some degree of certainty of what it will be like.

Communications and Electronics are important to us today and will be increasingly so tomorrow. We have tried to capture some of their significance in our Convention theme:

"Communications and Electronics—The Arm of Control, The Voice of Command."

Convention Speakers

Admiral Arleigh Burke, USN
Chief of Naval Operations

KEYNOTE LUNCHEON SPEAKER

Born far from the sea in Colorado in 1901, Admiral Arleigh A. Burke graduated from the United States Naval Academy in 1923 and later received his Master of Science degree in engineering from the University of Michigan. Possessing a pleasing personality, enthusiastic spirit and prodigious energy, Admiral Burke has shown executive ability and outstanding leadership which have made him a career officer under whom naval men consider it a privilege to serve.

During World War II, he received orders to the South Pacific where he successively commanded Destroyer Divisions 43 and 44, then Destroyer Squadrons 12 and 23. All America knows of his battle successes and to this day respects highly his title of "31-knot Burke." Admiral Burke's outstanding naval service earned for him the position of Chief of Naval Operations in 1951. Listed among his numerous combat awards and decorations during 37 years of naval service are the Distinguished Service Medal, the Navy Cross, the Legion of Merit and the Purple Heart.

★ ★ ★ ★

BANQUET SPEAKER

Space does not permit the listing of the wealth of experience or the accomplishments of our distinguished banquet speaker, Leo Cherne, Executive Director of the Research Institute of America since 1939.

Born in New York City in 1912, Mr. Cherne graduated from New York University and later from Georgetown University School of Foreign Service where he subsequently served on the faculty. He was admitted to the New York State Bar in 1934, and in June 1951 he was awarded an honorary degree of Doctor of Law from Parsons College. He is a regular lecturer at the United States Military Academy, the Industrial College of the Armed Forces and the New School of Social Research. He speaks with a depth of knowledge and conviction seldom equaled and his public appearances on the most provocative issues affecting our national welfare are a matter of record. He has served on the Board of Directors of the International Rescue Committee since 1953 and is Director of the American Arbitration Association and Director and Vice President of Freedom House. Mr. Cherne has published many books and articles and is a recognized sculptor.

Leo Cherne, Executive Director,
Research Institute of America

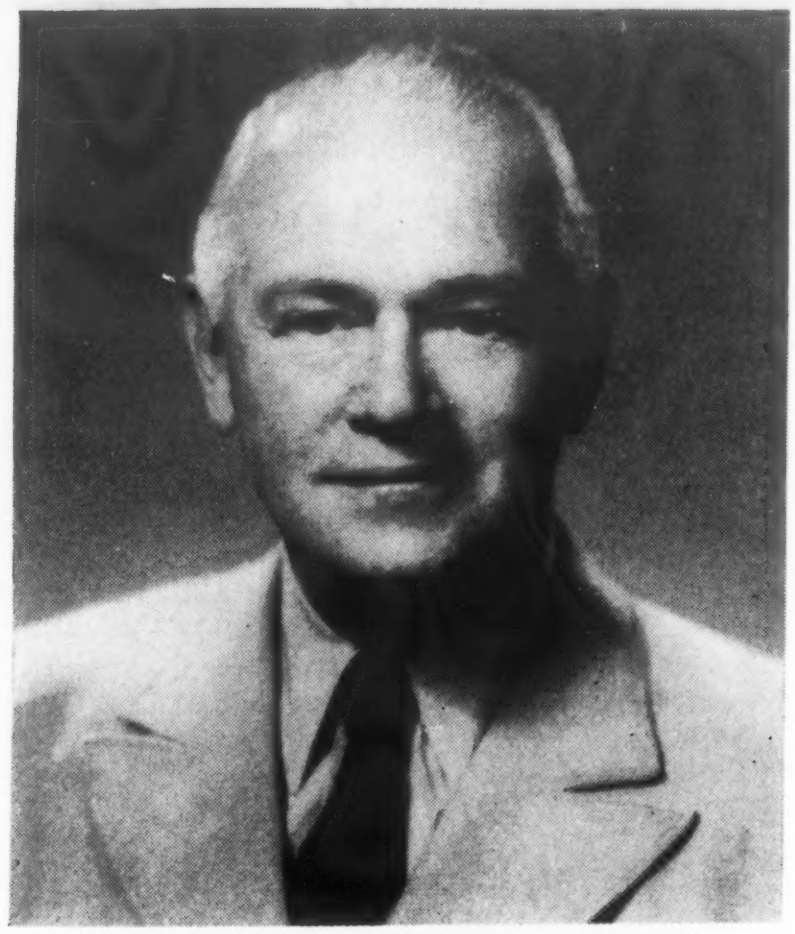
★ ★ ★ ★

Maj. Gen. George I. Back, USA (Ret)
Assistant to the President,
International Resistance Co.

INDUSTRIAL LUNCHEON SPEAKER

An honorary life member of AFCEA, Major General George I. Back has been active in the communications field since World War I. Since retiring as Chief Signal Officer of the United States Army in 1955, he has been with the International Resistance Company as Assistant to the President and was named a Director in January. Seldom does one find a man who has distinguished himself both as an outstanding military leader and as a civilian executive. General Back has given a lifetime of unselfish devotion to the advancement of communications and his accomplishments read like a "Who's Who." His many contributions to the improvement of United States Army Signal Corps communications led to his selection as the first Signal Corps Officer on active duty to receive the Fellow Award from the Institute of Radio Engineers.

General Back is a graduate of the Morningside College in Sioux City, Iowa, the communications engineering school at Yale University, the United States Army Signal Corps schools and the Command and General Staff School at Fort Leavenworth.



Communications and Electronics

The Arm of Control—The Voice of Command

W. J. BAIRD
General Manager and Editor

THE QUESTION of man's insatiable drive to travel at supersonic speeds. circle the universe and communicate at the speed of light will be much in evidence at the Armed Forces Communications and Electronics Association's 14th Annual Convention at the Sheraton-Park Hotel in Washington. D. C., May 24, 25 and 26. Some of the answers to this question will be found during the four morning panel sessions—others will be revealed in the 160 equipment exhibits portraying the ultimate in technological developments in the communications and electronics field.

The whole scheme of things at this year's show is built around the Convention theme. "Communications and Electronics—The Arm of Control, The Voice of Command." A phrase perhaps but one with present and future, industry and military connotations. AFCEA aims high and its individual members concentrate on future progress, for it is their conviction that past performances do not warrant a confident outlook. So infectious is the idea of progress that government and industry's engineers, scientists, researchers, educators and management, to name a few, stand ready at the door step of Defense to demonstrate and explain tomorrow's achievements—be it instrumentation to record the heart beat of a penquin or the problems inherent in putting a man in space.

The most important factor in the world today which will determine the success or failure of our future progress and shape and mold our courses of action is the strength or weakness of our economic system. With the coming of the space age superimposed upon a young but vigorous thermonuclear era, a whole new dimension has been added to our economic structure. Never before in history has an understanding of this factor by the American people meant so much. This is the foundation on which we must build in an ever expanding way if we are to have a strong national posture. One has only to reflect upon the speed and devastating consequences of modern warfare to realize that the nation cannot afford to be in a position of complacency on the issue of preparedness. Even with a nuclear stalemate, the delicate balance betwen peace and instantaneous war can be likened to a man swaying precariously on a needle point atop the Empire State Building. Even up there, there is a chance for making progress by keeping proper balance. This we must do.

One of the great paradoxes of this modern era is that the United States with its most advanced industrial system and know-how has been at the same time a nation which found itself least prepared to mobilize its resources when confronted with national emergencies in the past. Probably some good reasons could be advanced for America's traditional unpreparedness in time of conflict but today they would be difficult to accept and hard to comprehend.

Historically, our nation has been preoccupied with the advantage of a cushion of time and a cushion of space to the exclusion of modern realities. We had time to awaken a complacent America—time which allowed us to mobilize our abundant natural resources—time to gear our industrial might for the production of goods and services in support of our national requirements. Simply, my point is that no longer is it sufficient to plan merely for the conversion of our great industrial complex to the production of hard goods alone. We must learn to balance the heavy requirements for a strong military preparedness posture against the needs of a viable expanding economy. The hard and soft goods and services which comprise our gross national product must be in harmony if we are to avoid the pitfalls of an economic depression.

The position of world leadership was thrust upon us over a decade ago. We must use it wisely if we are to maintain it in this rushing, swift pace of progress. If we adhere to the principle and thinking that this United States stands out as the protector of a way of life which is under constant surveillance by other nations of the world, we should be morally worthy of imitation in our actions and planning for national and economic security.

There is no better assembly in which to learn first hand the problems inherent in future technology, scientific or production engineering in the communications or electronics industries or the challenging predictions of things to come than at the 14th AFCEA Convention and Exhibition. AFCEA is gathering to preserve and foster the spirit of fellowship; to promote efficiency and further the general growth and development in the communications and electronics field; and to encourage measures to strengthen the national defense.

As a final word let me remind you of the words spoken by Pericles 2300 years ago, "Fix your eyes upon the greatness of your country, as you have it before you day by day, and when you feel her great, remember that her greatness was won by men with courage and honor in action."

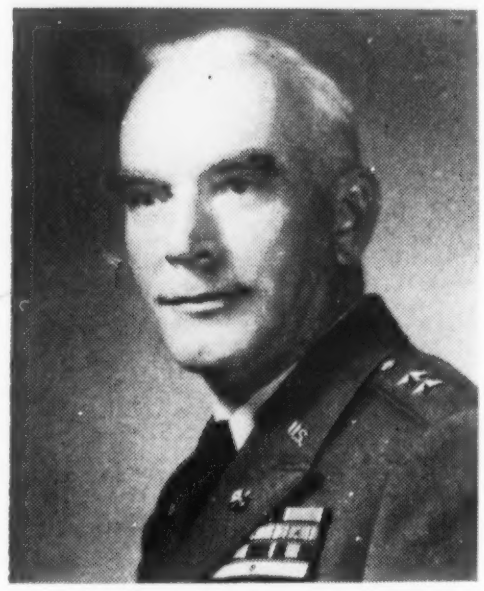
service communicators send greetings

In this era of powerful new weapons of tremendously increased ranges, communications and electronics assume a more critical importance in command control than ever before. In today's Army, the American soldier is a high order of fighting man and specialist—tops in skill, science and ability. The same high order of communications and electronics systems is needed for the controlled dispersal and rapid movement of military forces of which he is a part.

This year's theme is appropriately keyed to this compelling issue—"Communications and Electronics—The Arm of Control, The Voice of Command."

Responsive command control to the Army implies continuous advancement in the fields of stategic and tactical communications, combat surveillance and target acquisition, electronic warfare, avionics for Army aircraft and the broadening demands of space and satellite electronics and communications.

Our country's prime asset for success in these endeavors is the joint military-industry partnership, as represented by AFCEA, and the combined resources, experience and technological skills which this team possesses.



Maj. Gen. R. T. Nelson
Chief Signal Officer, USA

★ ★ ★ ★

RAdm. Frank Virden, USN
Assistant Chief of Naval Operations (Communications)/Director, Naval Communications

The 1960 AFCEA Convention theme, "Communications and Electronics—The Arm of Control, the Voice of Command," is an excellent slogan, but it is far more than a slogan. It serves to keep our attention and efforts focussed on the objective that military communications and electronics be integral with the military body, its movements, operations, weapons and all the other functions which make it a powerful, efficient fighting mechanism.

A "black box" designed just as a "black box"—i.e., to perform some limited electronic function—is out of style. We cannot meet modern requirements with an assemblage of black boxes tied together to meet an assemblage of requirements. System design has replaced black box design; the communications-electronics input of the system design must be fed in at the earliest stages of planning. Otherwise the "Arm of Control" will be slow and weak, and the "Voice of Command" will not be loud and clear.

Since its organization in 1946, AFCEA has helped greatly in building understanding between the military and industry. Through SIGNAL Magazine, monthly meetings and annual conventions, a many-faceted relationship is established. In this relaxed and friendly professional environment a full exchange of meaningful ideas can be achieved.

★ ★ ★ ★

Another year of splendid progress has brought us to the 14th Annual Convention of AFCEA. This year the Convention theme focuses attention on the vital twin objectives which are paramount in our work in the Air Force—command and control of the fighting forces. The present and future array of aerospace weapon systems, both manned and unmanned, call for unprecedented achievements in communications and electronics. To the extent that the past may point to the future, I am confident that these achievements will be forthcoming. The joint efforts of the military and industrial segments of our national defense will yield what is needed, as they always have.

Imagination, initiative and free enterprise, coupled with the stimulus of government-industry organizations like AFCEA, provide the creative climate most favorable to our binary sciences of communications and electronics. The military establishment and industry alike now must exploit this favorable environment to the fullest, to assure effective command and control of the fighting forces in the aerospace age.

Maj. Gen. Harold W. Grant, USAF
Director, Communications-Electronics

AFCEA NATIONAL CONVENTION PROGRAM

- 83 Exhibitors
- 160 Exhibit Units
- 4 Panel Discussions
- Trip to Naval Research Laboratory
- 6 Important Social Events
- Special Program for Ladies

PROGRAM OF EVENTS

Tuesday, May 24th

9:30 AM to 11:30 AM—**Panel Discussion—Communications and Electronics for Putting a Man into Space**
Moderator: Herbert Rosen, National Aeronautics and Space Administration
(To be introduced by John R. O'Brien, Hoffman Electronics, Washington AFCEA representative.)
Sheraton Hall

12 Noon—**Opening ceremonies—Moon Relay Demonstration**
Hotel Foyer

12:30 PM—**Keynote Luncheon**
Speaker: Admiral Arleigh Burke, USN, Chief of Naval Operatons
Sheraton Hall

2:30 PM—**Regional Vice Presidents' and Chapter Presidents' Meeting**
Caribar Room

4:00 PM—**Council and Directors' Meeting**
Caribar Room

6:30 PM—**Reception**
Florentine Room

7:30 PM—**Buffet Supper**
Sheraton Hall

Exhibits: 11:30 AM—7:25 PM

Wednesday, May 25th

9:30 AM to 11:00 AM—**Panel Discussion—Space Communications**
Moderator: Dr. J. R. Pierce, Bell Telephone Laboratories, Inc.
(To be introduced by Millard C. Richmond, Western Electric, Washington AFCEA representative.)
Sheraton Hall

11:00 AM to 12:00 AM—**Panel Discussion—Scientific Applications of Photography**
Moderator: RAdm. Robert S. Quackenbush, USN (Ret.)
(To be introduced by RAdm. Dwight M. Agnew, USN (Ret.), Washington Associates, Washington AFCEA representative.)
Sheraton Hall

12:15 PM—**Buses leave for Tour of Naval Research Laboratory**

6:30 PM—**Reception**
Florentine Room

7:30 PM—**Banquet**
Speaker: Leo Cherne, Executive Director, Research Institute of America
Sheraton Hall

Exhibits: 11:30 AM—7:25 PM

Thursday, May 26th

9:30 AM to 11:30 AM—**Panel Discussion—Industry Reports**
Moderator: Richard Shetler, General Electric Company
(To be introduced by Thomas B. Jacocks, General Electric, Washington AFCEA representative.)
Sheraton Hall

9:00 AM to 4:30 PM—**Special Exhibit by Armed Services honoring 100 years of U. S. Army Signal Corps Communications**
Sheraton Hall

12:30 PM—**Industrial Luncheon**
Speaker: Major General George I. Back, USA (Ret.), Assistant to the President, International Resistance Company
Sheraton Hall

Exhibits: 11:30 AM—4:30 PM

FOR THE LADIES

Tuesday, May 24th

Activities for the ladies will begin on Tuesday morning at 9:30 AM in the Madison Room with a "get acquainted coffee hour" and review of events to come. On Tuesday afternoon, a bus will leave from the Hotel at 2:00 for one of the embassies where tea will be served. The Reception will be held at 6:30 PM in the Florentine Room and the Buffet Supper will be at 7:30 PM in Sheraton Hall.

Wednesday, May 25th

The ladies will meet in the Madison Room for coffee at 9:30 AM. A bus will leave at 10:00 AM for a tour of the Pentagon, followed by luncheon at a private dining room in the Pentagon. After the luncheon, there will be an informal talk by Lieutenant Colonel Allerdice, Women's Army Corps. The Reception will be held at 6:30 PM in the Florentine Room and the Banquet at 7:30 PM will be held in Sheraton Hall.

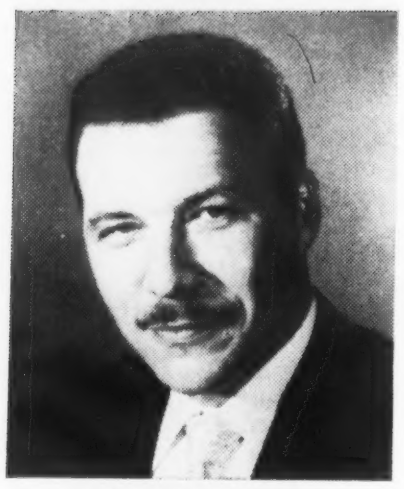
Mrs. Dorothy Christopher
Chairman, Ladies Activities

Thursday, May 26th

The ladies will gather in the Madison Room at 9:30 for a coffee hour. There will be a luncheon and fashion show in a nearby hotel for those who may wish to attend. The rest of the day will be free.

FOR LISTING OF EXHIBITS SEE PAGE 14

Panel Moderators



HERBERT ROSEN
Deputy Director of Information, National Aeronautics and Space Administration

DR. JAMES R. PIERCE
Director of Research-Communications Principles, Bell Telephone Laboratories, Inc.

RADM.
ROBERT S. QUACKENBUSH,
USN (RET.)
Engineering Div., Polaroid Corp.

RICHARD SHETLER
General Manager, Defense Systems Dept., General Electric Co.

Tuesday, May 24th

9:30-11:30—*Communications and Electronics for Putting a Man into Space, National Aeronautics and Space Administration*

INTRODUCED BY MR. JOHN R. O'BRIEN, HOFFMAN ELECTRONICS

PANEL MEMBERS:

Leonard Jaffee, NASA; Dr. Robert Coates, NASA; Robert Briskman, NASA; Dr. Nicholas Renzetti, Jet Propulsion Labs.

Herbert Rosen is highly respected for his depth of knowledge in the field of public relations. His pleasing personality, coupled with his executive ability and inborn trait to speak and write with conviction, has earned for him a reputation as a man of action. Following is a brief sketch of his background which eminently qualifies him for his present position as Deputy Director of Information, National Aeronautics and Space Administration: Graduate Engineer (BS) George Washington University; Washington Editor, Hayden Publications; Chief of Technical Information, ACF Electronics, a division of ACF Industries, Inc.; Member of AFCEA, Institute of Radio Engineers, Aviation Writers Association, National Press Club and American Institute of Physics.

Wednesday, May 25th

9:30-11:00—*Space Communications, Bell Telephone Laboratories, Inc.*

INTRODUCED BY MR. MILLARD C. RICHMOND, WESTERN ELECTRIC

PANEL MEMBERS:

Dr. James R. Pierce, Bell Labs; W. J. Jakes, Bell Labs; L. C. Tillotson, Bell Labs.

As Director of Research-Communications Principles at Bell Telephone Laboratories, Dr. James R. Pierce has been concerned, in general, with the technical problems of space communications and, in particular, with research work in radio, electronics, acoustics and vision, mathematics and group behavior. Prior to his present appointment, Dr. Pierce served as Director of Research-Electrical Communications and Director of Electronics Research. He received his PhD in 1932 from the California Institute of Technology and joined Bell Labs that same year. A writer of scientific books and popular scientific articles, Dr. Pierce is the recipient of the Eta Kappa Nu (outstanding young electrical engineer) award and has received various other awards.

Wednesday, May 25th

11:00-12:00—*Scientific Applications of Photography*

INTRODUCED BY RADM. DWIGHT M. AGNEW, USN (RET.), WASHINGTON ASSOCIATES

PANEL MEMBERS:

H. Schoene, General Precision Labs.; S. Sherr, General Precision Labs.; H. Meier, Aero Service Corp.; H. Butler, USASRDL; C. Coleman, Naval Photographic Interpretation Center; C. Bates, Office of the Deputy Chief of Naval Operations (Development)

Rear Admiral Robert S. Quackenbush, USN (Ret.), who is with the Engineering Division of Polaroid Corporation, has had many years of experience in the photographic field. Admiral Quackenbush was the first United States military officer to attend the British Photographic Interpretation School and he established and taught at the United States Naval Photographic Interpretation School. A graduate of the United States Naval Academy, Admiral Quackenbush served as Director of Photography at the Navy Department and was the Navy member of the Photographic and Survey Section of the Joint Chiefs of Staff.

Thursday, May 26th

9:30-11:30—*Industry Reports, General Electric Co.*

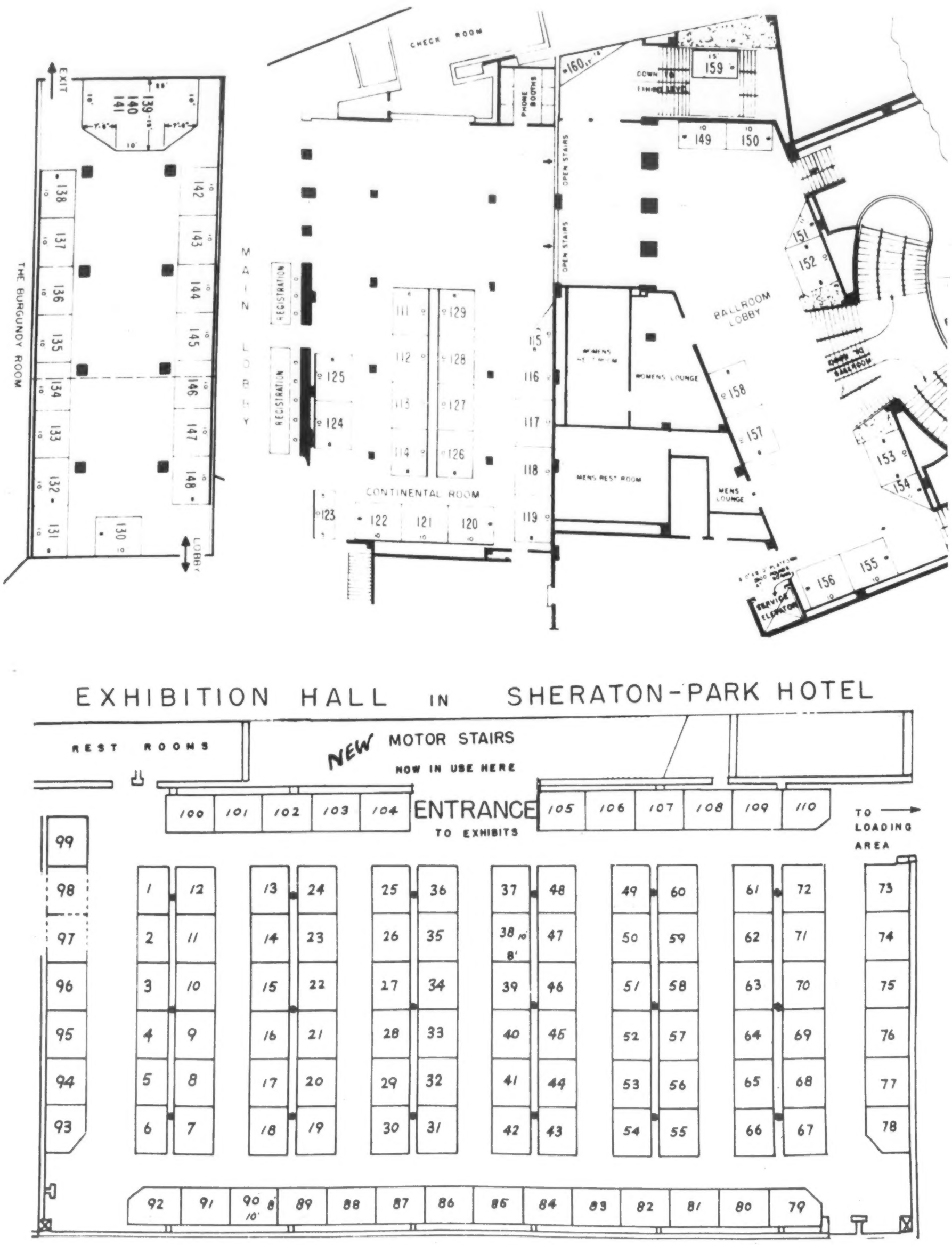
INTRODUCED BY MR. THOMAS B. JACOCKS, GENERAL ELECTRIC CO.

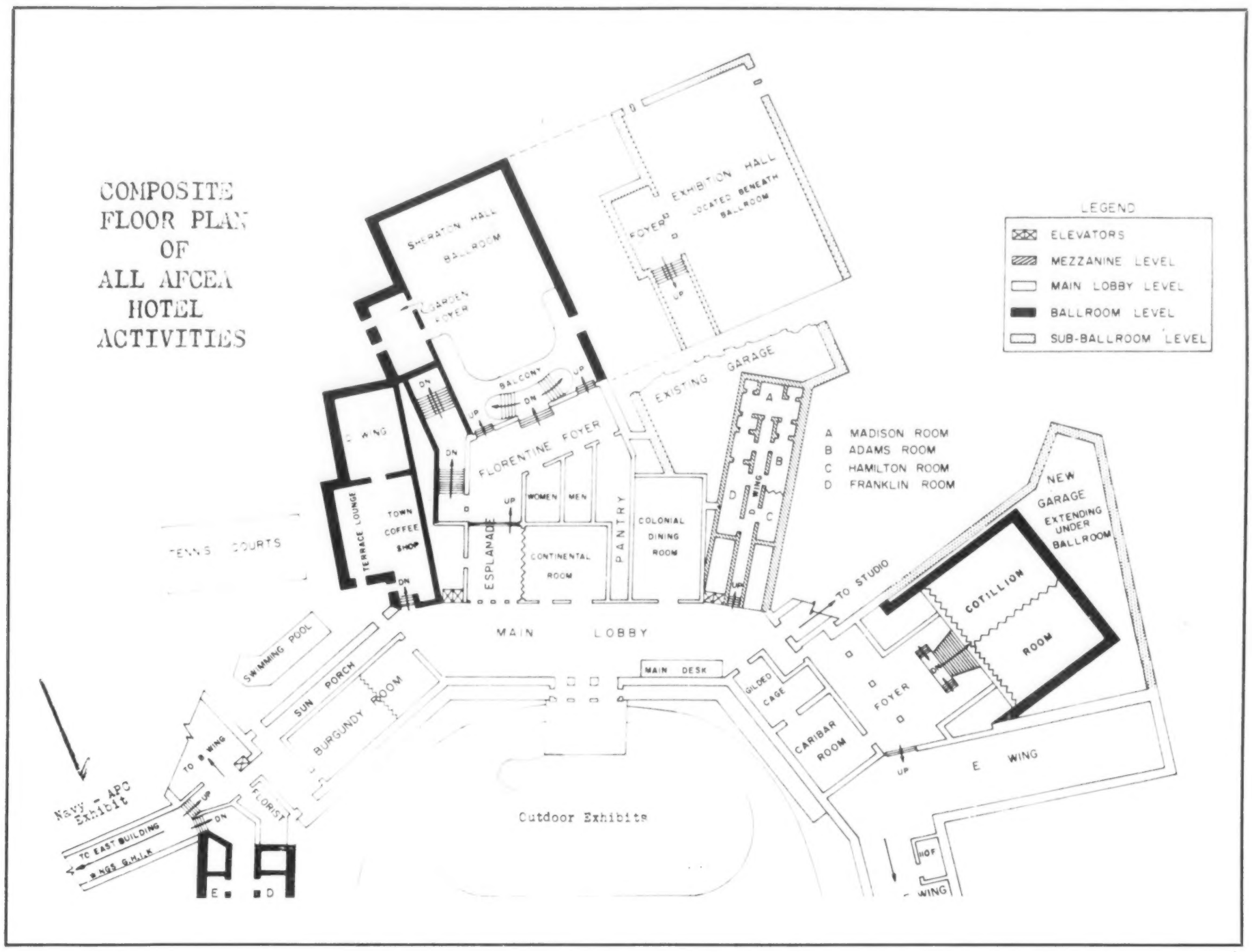
PANEL MEMBERS:

Lloyd Harriott, GE; Dr. William Glenn, GE; Albert Wild, GE; Richard Shetler, GE.

As General Manager of General Electric Company's Defense Systems Department, Richard L. Shetler has over-all responsibility for management of prime and support systems programs assigned to GE by the Armed Services. In his sixteen years with GE, Mr. Shetler has held the following positions: Manager, Special Radar Projects; Department Engineer; Unit Supervisor for Ground Radar Engineering and Major System Project Engineer. He received a bachelor of science degree in electrical engineering in 1943 from Ohio University and in 1959 was awarded a certificate of merit for Science from Ohio University.

EXHIBIT LOCATIONS





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14th ANNUAL AFCEA CONVENTION EXHIBITS

83 Exhibitors — 160 Exhibit Units

Index to Exhibits

[(S) *in listing indicates Signal Corps equipment*]

EXHIBIT MANAGEMENT

WILLIAM C. COPP & ASSOCIATES

72 West 45th St., New York 36, N. Y. • Murray Hill 2-6606

Adler Electronics, Inc., Communication Systems Div. Booth #110
1 Le Fevre Lane, New Rochelle, N. Y.
• *Emanuel Strunin, Ben Adler, Sheldon Newberger, Alfred Strogoff, Alwyn Carty*

Alden Electronic & Impulse Recording Equipment Co. Inc. Main Lobby
Westboro, Mass.
Weather-map service for AFCEA visitors.

All Products Co.
L. Garden, Southeast of B Wing, Outside East Corridor.
See: **U. S. Navy Exhibit**

Alpha Corp. Booths # 61, 62, 63, 64
Richardson, Texas
See: **Collins Radio Co.**

American Telephone & Telegraph Co. Booths #31, 32, 33, 44, 45, 46
See: **Bell Telephone System & Western Electric Co.**

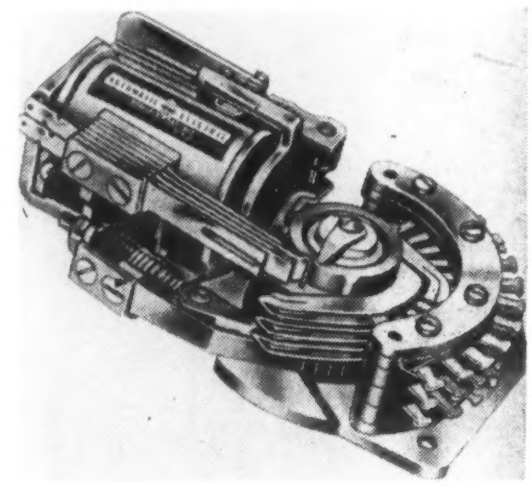
Ampex Corp., Ampex Professional Products Co. Booth #117
943 Charter St., Redwood City, Calif.
• *J. Joslow, G. Suddeth, T. Merson, D. Creswell, J. Woolley, J. Miller*
Ampex television tape system including VIDEO Tape Recorder and associated equipment.

Andrew Corp. Booth #125
P. O. Box 807, Chicago 42, Ill.
• *Lawrence Krahe*
BIFILAR Helical Antenna for tracking short and medium range targets. Copper Heliax—Flexible Air Dielectric Cable. HUBLOC antennas—large parabolic antennas featuring high surface accuracy, simple to install.

Antenna Systems, Inc. Booth #130
349 Lincoln St., Hingham, Mass.
• *Charles W. Creaser, Jr., W. W. VanderWolk, Jr., Albert K. Fowler*
Antennas and components used in radar, Communications and tracking systems.

Assembly Products, Inc. Booth #128
75 Wilson Mills Road, Chesterland, Ohio
• *Lloyd Rowe*
Meter-relays, panel meters, "versatrol" special purpose controllers, "simplytrol" indicating & controlling pyrometers, VHS meter-relays, CRMR meter relays. (All are used by Signal Corps.)

Automatic Electric Sales Corp., subsidiary of General Telephone & Electronics Corp. Booth #42
400 Wolf Road, Northlake, Ill.
• *E. E. McCorkle, J. W. Ayers, J. P. Costello, H. B. Bittner, E. D. Rolf*
(S) Type 44 and (S) Type 45 Rotary Stepping Switches; (S) Class B and (S) Class C Telephone-Type Relays; (S) PTW Polar Relay; New class W Wire-Spring Relay for switching 51 circuits simultaneously.



AE's Type 44, Rotary Stepping Switch

Automatic Telephone & Electric Co., Ltd. Booths #59, 60
Strowger House, 8 Arundel St., London, W. C. 2, England
• *H. R. A. Wood, W. H. Carsbury, R. C. Atherton*
Transportable multiplexing equipment. Telegraph tape reading auto-numbering sending equipment, TAA. Synchronous regenerative repeater. Crystal chronometer.

Bell Telephone System, American Telephone & Telegraph Co.
Booths #31, 32, 33
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• *W. Ford*
Up-to-date telephone communications including: the Call director, switchboards, speakerphone, telephone answering and recording, Dataphone. Automatic call distributing systems and private line networks.

Bendix Aviation Corp., Scintilla Div.
Booths #28, 29
See: **Scintilla Division**

Bendix Aviation Corp., Bendix Pacific Div. **Booth #30**
11600 Sherman Way, N. Hollywood, Calif.
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Bendix Aviation Corp., Bendix Radio Div. **Booths #73, 74**
E. Joppa Road (Towson), Baltimore 4, Md.
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Inertialess array 3-D Radar, Air Defense Radar, Air Traffic Control Radar, ECCM Devices, Ground/Air Communications, Airborne Radio Navigation, Twilight Scatter Communications & Detection, Air/Ground Data Links, Integrated Aircraft Radio Controls, Space Communications, Space Vehicle Tracking, Automatic Checkout Systems, Training Devices, Field Support.

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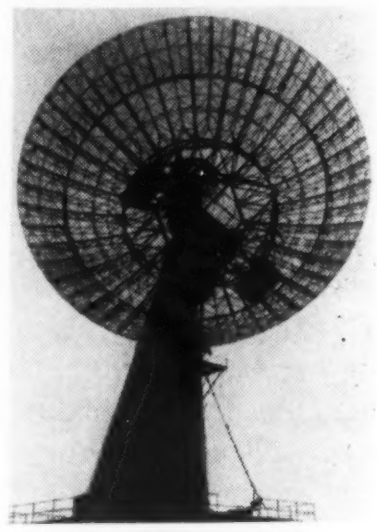
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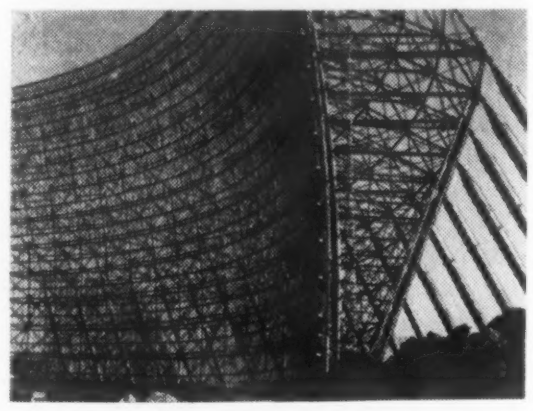

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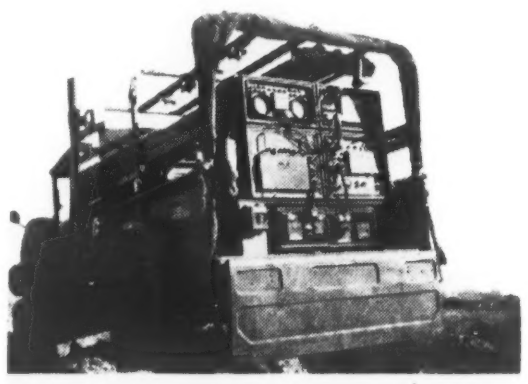

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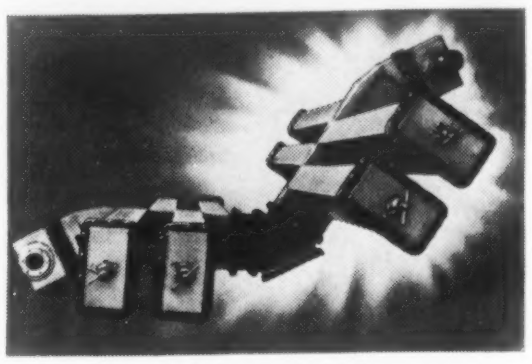

"Duplexer" Waveguide Component

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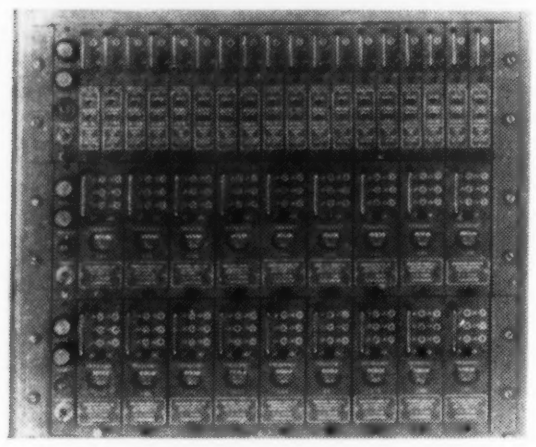
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Northrop Corp. Booth #34
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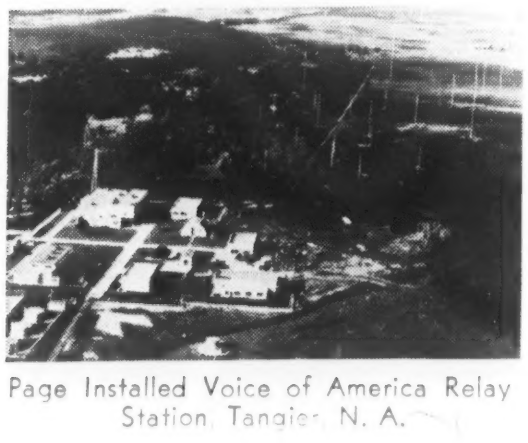
See: **Burndy Corp.**

Page Communications Engineers, Inc., subsidiary of Northrop Corp. Booth #34
2001 Wisconsin Ave., N.W., Washington 7, D. C.
• *Gail Boggs, Walter Brehm, Arnold Rosenberg, Joe Gaines*
Telecommunications Systems engineering and management for underseas, over-the-ground, transhorizon, and satellite systems: Feasibility studies, site surveys, planning, R&D, design, installation, operation, maintenance and training.


Page Installed Voice of America Relay Station, Tangier, N. A.

Philco Corp., TechRep Div., Government-Industrial Div., Lansdale Tube Co. Div. Booths #25, 26, 27
"C" and Ontario Sts., P. O. Box 4730, Philadelphia 34, Pa.
• *N. P. Dewees, C. Simms, L. G. Becker, P. Plant, M. Snyder*
(S) Field Engineering Service; (S) Radar & Communications Equipment; (S) Semiconductors.

Prodelin Inc. Booth #43
307 Bergen Ave., Kearny, N. J.
• *A. Haselman, L. A. Bondon, R. Marchese, G. B. Voorhis, Jr.*
(S) SPIR-O-LINE—Coaxial Cable and Connectors. (S) RIGID '800'—Copper Transmission Line and Accessories. RIGID '800'—Aluminum Transmission Line and Accessories. 2-Way Mobile Radio Base Station Antennas. (S) Microwave Parabolic Antennas.

Radiation, Inc. Booths #71, 72
Melbourne, Fla.
• *L. P. Clark, Jr., C. J. Underwood Jr., D. Casale, H. Trenner, Ed Hartley*
Telegraph Distortion Measuring System; Radilog-System Standardization through NOR logic; Regenerative Repeaters.

Radio Corporation of America: Defense Electronic Prod. Div., Camden, N. J.; Astro-Electronic Prod. Div., Princeton, N. J.; Electronic Components Div., Harrison, N. J.; RCA Service Co., Cherry Hill, N. J. Booths # 49, 50, 51
• *J. R. Dunn, C. M. Gilbert, T. F. Shannon, W. S. Hahn, W. F. Zimmerman*
Integrated display showing tubes and semiconductor components and featuring a model of the "Tiros" satellite.

Radio Corporation of America: Closed-Circuit Television Div., Electronic Data Processing Div. Booths #55, 56, 57, 58
Front & Cooper Sts., Camden 2, N. J.
• *P. A. Greenmeyer, A. F. Inglis, M. Berry, P. Berquist, J. Cassidy, K. B. Russell*
RCA Closed Circuit Television Equipment for application to military training, communications, and monitoring. TV Cameras, TV Tape Recorder, Weather Vision, TV Briefer.. Also MUX-ARU-2 Equipment for Error Correction of Teletype on Radio Circuit.

Radio Engineering Laboratories, Inc. Booths #66, 67, 68
29-01 Borden Ave., Long Island City 1, N. Y.
• *D. F. Koijane, M. Kraus, G. Papamarcos, F. Gunther, H. Sadenwater, H. H. Robinson, J. Day, T. P. Rizzuti*
Tropospheric Scatter & Single Sideband Communications Equipments; Unitized Beam Power Supplies for 10 KW Klystrons; REL type 942, 680-970 MC 10 watt output; SSB Multi Channel 100-1000 watt Transmitters, Receivers, Commercial, Military & Amateur Systems.
See: **Dynamics Corp. of America, Eldico Electronics, Standard Electronics Div.**

Radio Frequency Laboratories, Inc., Communications Equipment Div. Booth #119
Powerville Rd., Boonton, N. J.
• *Richard M. Treible, Henry H. Emker*
Transistorized and Tube Type Frequency Shift Carrier. Analog Telemeters. Frequency Shift Converters. Transistorized Output Keyers. Associated Accessories.

Rauland Corp. Booths #151, 152
Chicago, Illinois
See: **Zenith Radio Corp.**

Raytheon Co., Missiles Systems Div., Equipment Div. Booths #9, 10, 11, 12
101 River St., Waltham 54, Mass.
• *R. K. Clarke, G. Halterman, R. Kendall, M. Curran, E. Forgione*
Manufacturer of Wide range of Military and Commercial Electronic products, including AN/TRC-27 portable Communications System, complete Hawk & Sparrow III Missile Systems, Sonar for the Navy's submarines, and tubes which are used in more than twenty-one of our nation's missiles.

RAYTHEON

Reeves-Hoffman Div., Dynamics Corp. of America Booth #70
145 Cherry St., Carlisle, Pa.
• *C. M. Rahn, R. L. Van Gavree*
Crystal Units, Filters, Oscillators.

Reeves Instrument Corp. Booth #69
East Gate Blvd., Roosevelt Field, Garden City, L. I., N. Y.
• *C. Lax, A. J. DiMarco, M. Travers, D. Muller, F. LaBarbara*
Gyros, Resolvers, Servo-Mechanical Components, Computer Amplifiers, Radar, Guidance Systems and Components.

Remington Rand Univac, Div. of Sperry Rand Corp. Booths #93, 94, 95
315 Park Ave., So., New York 10, N. Y.
• *J. A. Grundy, R. H. Winkler, R. P. Daly, D. R. Walters, C. J. Knorr*
Univac Electronic Computing Systems.

Republic Aviation Corporation, Special Products & Services—Missile Systems Div. Booths #2, 3, 4
Farmingdale, Long Island, N. Y.
• *Wallace C. Budny, Austin Speed, Robert Sherry, Jack Curtis, William Ryder, Al Simmon*

Electronic Systems. TRUFOAM (Radar Lens Material). Radar Reflectors. Micro Modules (DICE). Battery Chargers & Testers (Nickel Cadmium & Silver Zinc).

Rixon Electronics, Inc. Booth #21

2414 Reedie Dr., Silver Spring, Md.

• *D. W. Perry, Homer Ray, Dick Wainwright, Marvin Frank, Bruce McKay*

(S) 500 to 5000 bit date transmit-receive equipment for 3KC voice lines. (S) Transistorized relays. (S) Envelope Delay Equalizer. Special filters, fixed and tuneable, low noise pre amps, RF systems.

Royal McBee Corp. Booths #155, 156

Westchester Ave., Port Chester, N. Y.

• *Tom W. Boman, John C. Fulton, Gregory Sheridan, Robert T. Perry, David G. Morgan*

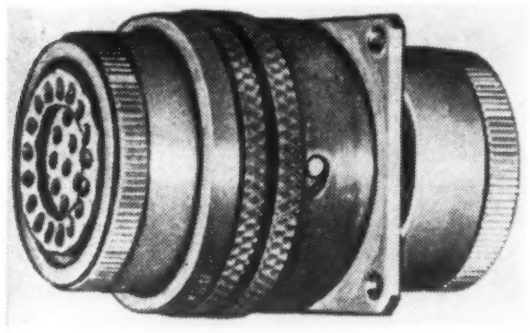
Royal Precision LGT-30—an internally-stored program, general purpose electronic digital computer which solves wide range of scientific, engineering, business and statistical problems. Available as optional equipment is photo-electrical reader capable of reading punched paper tape at 200 characters per second and punching twenty characters per second.

Scintilla Division, Bendix Aviation Corp. Booths #28, 29

Sidney, N. Y.

• *D. W. Newcomb, Ralph E. Rice, Fred N. Bulken, Harold Gallup, S. B. Merritt*

Electrical Connectors — MS, Pygmy Miniature, Heavy Duty, Umbilical, Rack & Panel and other types; Cable and Harness Assemblies; High Temperature Capacitors; M. C. Jones Test Equipment for RF Coaxial Transmission Lines.



Bendix "Pygmy" Electrical Connector

Shepherd Industries, Inc. Booth #135

103 Park Ave., Nutley 10, N. J.

• *J. French, D. Giffin, Dr. Duerig, W. Murphy, A. Leuthesser, D. Killen, L. Driggs, D. Coll, D. Carpenter*

Digital Tape Transports, Bin Type & Airborne; Digital Magnetic Memory Drums; Magnetic Heads for Tape Transports and Drums; Logic Circuitry, Solid State Amplifiers; Analog Tape Transports.

The Singer Manufacturing Co., Singer Military Products Div. Booth #124

149 Broadway, New York 6, N. Y.

• *F. W. Howells, Noble C. Harris, Robert E. Alderman, Victor J. Sykes, T. H. Orndoff*

(S) The Manhattan Strip; Servo-Motors; High-Shock Switches; (S) RF Systems; (S) RF Amplifiers.

Slip Ring Company of America Booth #150

3612 W. Jefferson Blvd., Los Angeles 6, Calif.

• *Alfred D. Langille, Don A. Hausrath, Robert E. Wolfe, Charles Gehrke*

Sable Platform Slip Rings & Staple Platform Simulator for Testing. Noble Metal Slip Ring and Switching Devices.

Smith-Corona Marchant, Inc. Booths #53, 54

See: **Kleinschmidt Laboratories, Inc.**

Specialty Electronics Development Corp. Booth #114

115 Eileen Way, Syosset, L. I., N. Y.

• *William Prichep, H. Russell Cammer, George J. Gill, Moses Cammer, David Alster*

(S) Hermaphrodite Connectors; Dosimeter Readers; Wavemeter; Local Oscillator; Duplexer; Variable Attenuator; Radiac Set.

Sperry Rand Corp. Booths #93, 94, 95

See: **Remington Rand Univac**

Standard Electronics Div., Radio Engineering Laboratories, Inc. Booths #66, 67, 68

See: **Reeves Instrument Corp.**

Stelma, Inc. Booth #16

200 Henry St., Stamford, Conn.

• *I. Gallatin, J. O. Erickson, Norman Sugarman, J. Corless, H. Segal*

DAC V Data Analysis Center—an integrated grouping of new digital test equipments for analyzing the quality of data/telegraph circuits and equipments. Transistorized distortion measuring sets, test pattern generators, modulation rate converters, etc.

Stevens Manufacturing Co., Inc. Booth #160

P.O. Box 1107, Mansfield, Ohio

• *W. Stevens, G. Rouse, R. Stevens, W. Stevens, Jr., J. Jessen*

Complete line of semi-enclosed and hermetically sealed bimetal thermostats for the electronic industry. Both positive acting and snap-acting, extremely close differentials and good for hundreds of thousands of operations.

Stromberg-Carlson Co., Div. of General Dynamics Corp. Booths #88, 89, 90, 91, 92

100 Carlson Rd., Rochester 3, N. Y.

• *David S. Cook, Thomas Leitch, William Lucas, Henry C. Sheve, Carl England, P. B. Johnson, Morris L. Hansen*

ARM-22 TACAN Test Set, SCATE—Stromberg-Carlson Automatic Test Equipment, Spectrum Analyzer, (S) Electronic Switching, BASIC (Battle Area Surveillance and Integrated Communications), etc.

The Superior Electric Co. Booths #144, 145

83 Laurel St., Bristol, Conn.

• *F. A. Molander, R. Mosher, A. Broshkevitch, J. Cann, W. Selens*

(S) POWERSTAT Variable Transformers, (S) STABILINE Automatic Voltage regulators, FLEXIFORMER Packaged Transformer Primaries, VARICELL Adjustable A-C/D-C Power Supplies, SLOSYN Synchronous Motors, DUB-L-PLUG Dual Electrical Connectors, SUPERCON Electrical Connectors, EXEL Loading Reactors, POWERSTAT Decade Line Correctors.

Sylvania Electronic Systems Div., subsidiary of General Telephone & Electronics Corp. Booths #39, 40, 41

63 Second Ave., Waltham 54, Mass.

• *F. H. Russell, A. W. Christopher, W. S. Davis, W. H. Adams, J. W. Donoho*

This is Sylvania Electronic Systems: "Government Systems Management for G. T. & E." Listing the combined resources-capabilities of G. T. & E. including Automatic Electric, Lenkurt, G. T. & E. Laboratories, General Telephone System, Leich, and Electronic Secretary Industries.

Technical Materiel Corp. Booths #7, 8

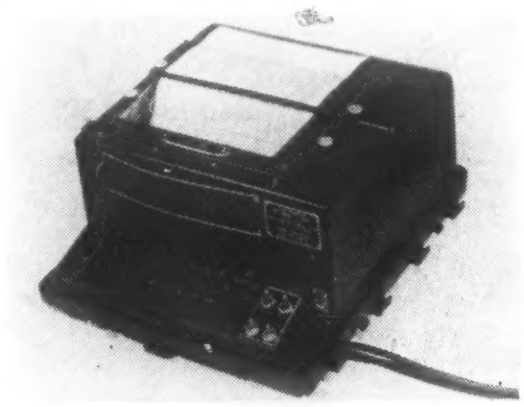
700 Fenimore Rd., Mamaroneck, N. Y.

• *E. A. Matson, Jr., William L. Deans, Jack Caputo, Donald B. Craft, Henry J. Geist*

(S) Single Sideband Transmitters 1-40KW; Single Sideband Receiving Systems; Complete Communications Systems; Frequency Synthesizors; Transmitting & Receiving Antenna Matching & Terminating Devices; Remote Control Receivers; Multicouplers.

Teletype Corp. Booths #19, 20

4100 Fullerton Ave., Chicago 39, Ill.



New Light-Weight Signal Corps Printer

• *Ralph Larsson, Lou Holtz, Jack Seifried, Ken Wood, Carl Fischer*
Latest Teletype Communications equipment for military application; Featuring the new (S) light-weight military page printer; new Model 28 100 WPM Torn-Tape System; (S) M28 Automatic Send-Receive Set and (S) M28 Send-Receive Page Printer.

Texas Instruments Incorporated, Semiconductor-Components Div.
Booths #98, 99

P. O. Box 312, 13500 N. Central Expressway, Dallas, Texas

• *James R. Alderdice, Jim Carland, Frank Clarke, Ace Adams, Bill Porterfield*
(S) Solid Circuit Semiconductor Networks, Silicon and Germanium Transistors, Gallium Arsdnide Tunnel Diodes, Silicon Diodes and Rectifiers, Solid Tantalum Capacitors, Resistors, and Light Sensors.

Thompson Ramo Wooldridge Inc.
Booths #75, 76, 77, 78

Cleveland 17, Ohio & Los Angeles 45, Calif.

• *James A. Cooper, Charles Chase, John McCarthy, Norm Wuerz, Bob Myers*
(S) Electronic Components, Sub Systems and Systems, (S) Microwave Equipment, Digital Process Control Computers, (S) Special Purpose Antennas, Data Processing Equipment, Electronic Language Translation Systems, (S) Closed-Circuit TV, Infra-Red, (S) Micro-miniature Diodes & Capacitors.

Three Point One Four Corp.
Booth #159

24 Woodworth Ave., Yonkers, N. Y.

• *J. J. Root, Richard Sapolin*
Silver Chloride Secondary Rechargeable batteries and primary batteries self-activating or externally activating. Copper Chloride Secondary rechargeable batteries and primary batteries self-activating or externally activating. Brand new development.

Trak Electronics Co., Division of CGS Laboratories, Inc.
Booths #111, 112

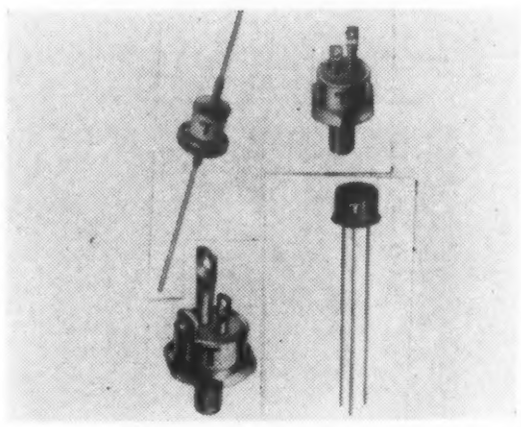
59 Danbury Rd., Rt. #7, Wilton, Conn.

• *Henry Pessah, M. L. Jackson, W. L. Gustavson*
(S) Antenna Multicoupler for 2-32 mc; (S) 50-100 mc panoramic receiver; (S) Miniature INCREDUCTOR high frequency saturable reactors; (S) Tunnel diode characteristic tester; Morse to teleprinter code converter; "S" and "C" Band miniature cavities.

Transitron Electronic Corp.
Booths #157, 158

168 Albion St., Wakefield, Mass.

• *H. Thomas Neavitt, Robert Lynch, Robert Fleishman*
Silicon Transistors, Silicon Controlled Rectifiers, Silicon Rectifiers, Silicon Voltage Regulators and References, Silicon and Germanium Diodes, Silicon Carbide Rectifiers and Micro-Miniature Diodes. (All for Signal Corps.)



Top: New Carbide & $\frac{7}{16}$" Controlled Rectifiers. Bottom: $\frac{11}{16}$" Controlled Rectifiers & Transwitch, Diffused Mesa Transistor.

U. S. Navy Exhibit (All Products Co.)
L Garden, Southeast of B Wing, Outside East Corridor

Equiangular spiral antenna for high frequencies. First time full scale (96 feet) shown in actual operation.

Vitro Corporation of America
Booths #135, 136

See: **Nems-Clarke Co.**

Western Electric Co., Inc.
Booths #44, 45, 46

195 Broadway, New York 7, N. Y.

• *C. R. Pritchett, E. J. Zilian, W. R. Hyatt, J. W. Catharine*
Various communications systems built by the Western Electric Co., for government agencies are shown on an activated exhibit. Electronic and telephone equipment are also displayed.

The Western Union Telegraph Co.
Booths #79, 80

60 Hudson St., New York 13, N. Y.

• *George I. McFatter, W. W. Alvis, J. A. Pence, W. H. Bowen, Ruby Gerhold*
Data Transmission Equipment.

Westinghouse Air Brake Co.
Booth #103

See: **Melpar, Inc.**

Westinghouse Electric Corp., Air Arm Div. Booths #107, 108, 109

Box 746, Friendship International Airport, Baltimore 3, Md.

• *J. R. Shober, A. F. Young, Jr., R. S. Purinton, K. F. Dussinger, A. L. Spencer*
Advanced military airborne electronic systems and concepts including demonstration of new Molecular Electronic Systems, Data Processors, Armament Control Radar, Infrared and other detection and tracking techniques.

Westinghouse Electric Corp., Electronics Div. Booths #105, 106

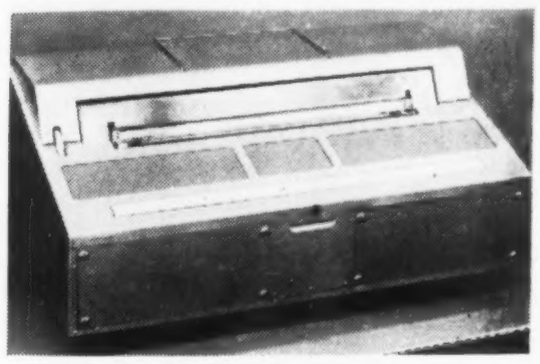
Box 1897, Friendship International Airport, Baltimore 3, Md.

• *G. D. Waldorf, J. R. Joseph, C. A. Utesch, T. J. Cawley, F. W. Fischer*
Space application of the Paraballoon Air-Supported Antenna. Radar developments at the Electronics Division.

Westrex Corp., Division of Litton Industries, Inc. Booths #120, 121, 122

111 Eighth Ave., New York 11, N. Y.

• *W. P. Corderman, Karl Clough, George Steck, Henry P. Bechtold, Lawrence Truitt*
PLEXITEL SSB Equipment. Mark VII data Recorder, MONATEL Transceiver, Voice Operated Gain Adjusting Device, Type 60 Receiver. Privacy Equipment, Griffith Teleprinter. Times Facsimile Equipment.



Model RJ Continuous Recorder

Wincharger Corp. Booths #151, 152
Sioux City, Iowa

See: **Zenith Radio Corp.**

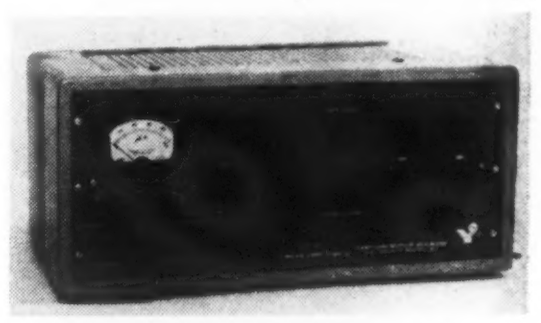
Winston Electronics, Ltd.
Booths #66, 67, 68, 69, 70

See: **Dynamics Corp. of America**

Yuba Consolidated Industries, Inc., Yuba-Dalmotor Div. Booth #142

1375 El Camino Real, Santa Clara, Calif.

• *James Booth, Bernard Bisnet*
Linear Amplifiers: Model DM1000—highly flexible, compact, mobile, designed for SSB operation, adaptable for multi-band service by means of easily interchangeable plug-in units. 1000 watts PEP power input; Model DM-4000—highly efficient, compact. 3000 watts PEP on SSB, also suitable for operation AM, FM, FSK, high degree of linearity, 2 to 30 MC, 2 to 5 bands.



Model DM4005 Linear Amplifier

Zenith Radio Corp. Booths #151, 152

6001 Dickens Ave., Chicago 39, Ill.

• *Scott B. Morency, Tom Snow, E. B. Passow, Roy Brewer*
Zenith Radio Corp.: Secondary Time Standard, Single Side Band Communications Instruments, Parametric Amplifier, Specialized Electronic Circuitry.
The Rauland Corp.: Special Purpose Tubes, Flat Face Tubes.
Wincharger Corp.: Portable Power Generating Equipment.
Zenith Radio Research Corp.: Flash X-Ray Equipment.

Zenith Radio Research Corp.
Booths #151, 152

Menlo Park, Calif.

See: **Zenith Radio Corp.**

FOR THE COMBAT MARINE

Stromberg-Carlson-San Diego, in cooperation with the U.S. Marine Corps, has developed a revolutionary new tactical communications concept that will instantaneously transmit intelligence from forward observers and present a simultaneous tactical display to command. Known as BASIC (Battle Area Surveillance and Integrated Communications), it works this way:

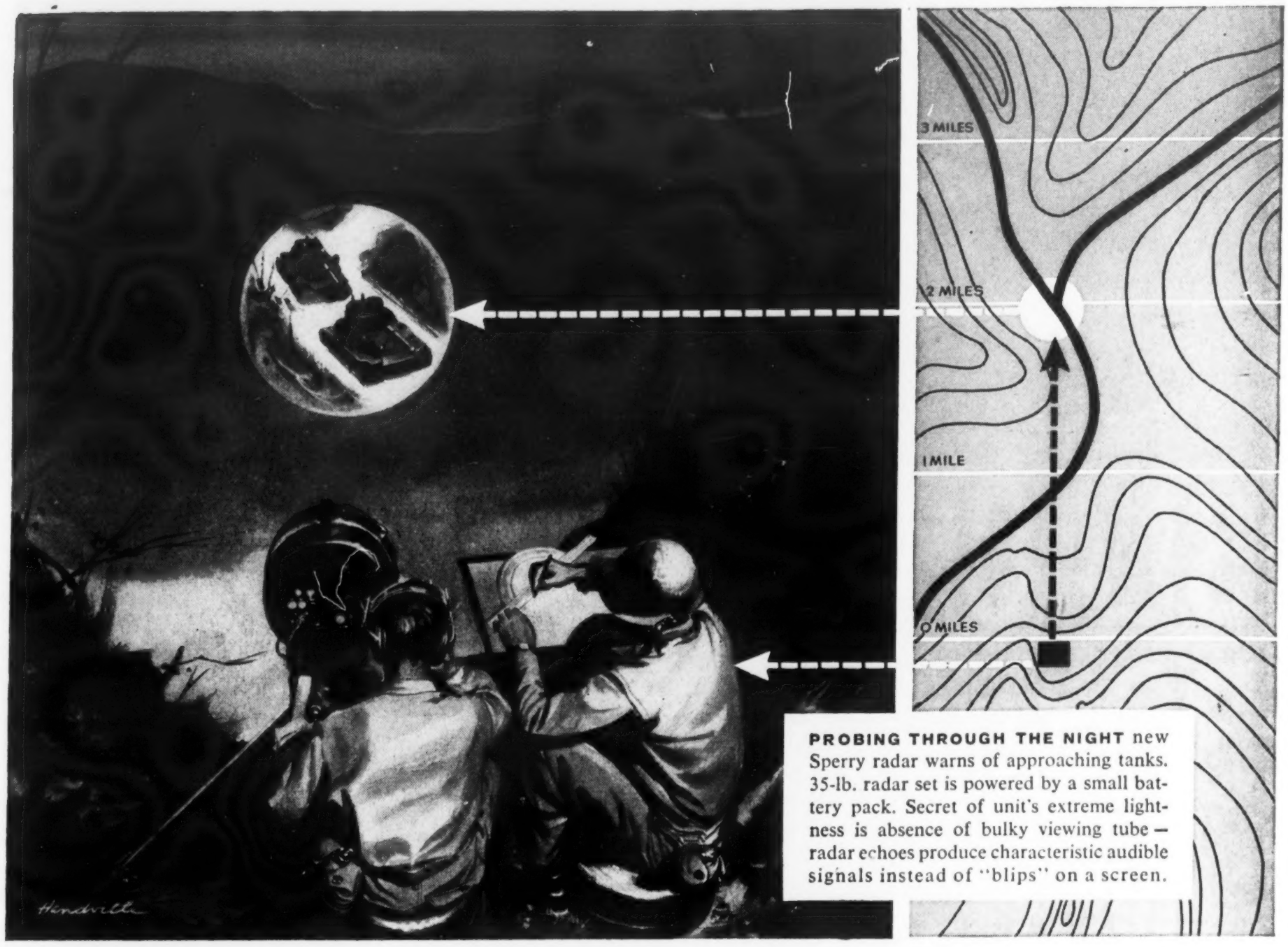
Forward observers are equipped with small, hand-held digital message generators on which reports are "set up" through a series of switches. After checking the accuracy of his message, the observer sends the entire message in a short burst over his standard field communications equipment. The burst transmission doesn't interfere with simultaneous voice communication over the same radio channel.

Back at the command post, surveillance information is instantly displayed on a tactical map and simultaneously presented on typewritten cards showing target identity, location and other important information. Data may be fed directly to tactical computers for artillery fire control.

The same techniques and equipment used for the Marine Corps' BASIC concept are readily adaptable to a multitude of other military and commercial communications and display systems. For information about how BASIC techniques can solve your problems, contact Stromberg-Carlson-San Diego, Dept. A-39, 1895 Hancock Street, San Diego 12, California. Telephone CYpress 8-8331.

STROMBERG-CARLSON-SAN DIEGO

A DIVISION OF **GENERAL DYNAMICS CORPORATION**



PROBING THROUGH THE NIGHT new Sperry radar warns of approaching tanks. 35-lb. radar set is powered by a small battery pack. Secret of unit's extreme lightness is absence of bulky viewing tube — radar echoes produce characteristic audible signals instead of "blips" on a screen.

Army has "Silent Sentry" Radar for front-line use

SPERRY RADARS range in size from the tiny "Silent Sentry" (above) to the giant Air Force Early Warning Radar, the AN/FPS-35 with its 85 ft. tower and 126 ft. antenna. These towers of strength in U.S. defenses will be spotted strategically throughout main Air Force defense networks.

Army troops are now able to call upon the country's first production equipment of this size. The device – designed to warn of surprise over-the-ground infiltration or major attack by an aggressor–greatly enhances the effectiveness of battle area surveillance.

Developed jointly with the Army Signal Corps, this new Sperry portable radar instantly reports any movement of men or vehicles within a three-mile range–at night, in fog or smoke. So accurate is the set that it can detect one soldier walking a mile away and can distinguish between a single individual and a squad of several men. It is also sensitive enough to determine the approximate size of a vehicle target and indicate whether it has wheels or tracks. This new "Silent Sentry" is one more result of the joint efforts of our military leaders and Sperry to keep our defenses up-to-date.

The "Silent Sentry" (AN/PPS-4) is one of a broad variety of radars manufactured by the Surface Armament Division of Sperry Gyroscope Company.

SPERRY

SURFACE ARMAMENT DIVISION, *SPERRY GYROSCOPE COMPANY • DIVISION OF SPERRY RAND CORPORATION, GREAT NECK, N.Y.*

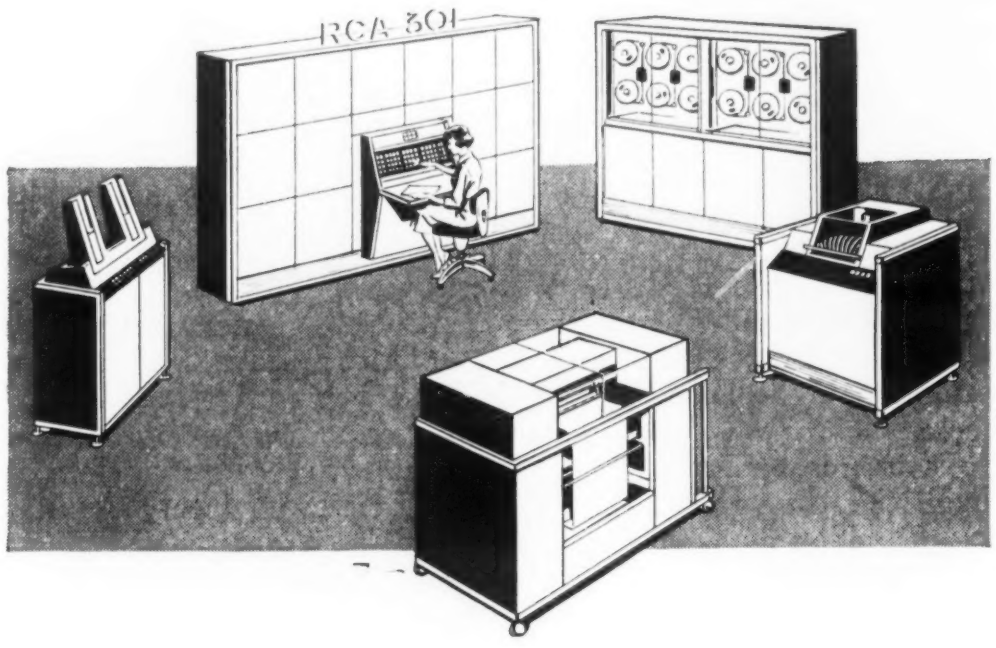
BIG NEWS

in ELECTRONIC DATA PROCESSING

Two new systems, latest in a series of EDP Advancements from RCA —world leader in electronics—join the established RCA 501

For Business in the Smaller Ranges • Divisional Operations

THE NEW RCA 301

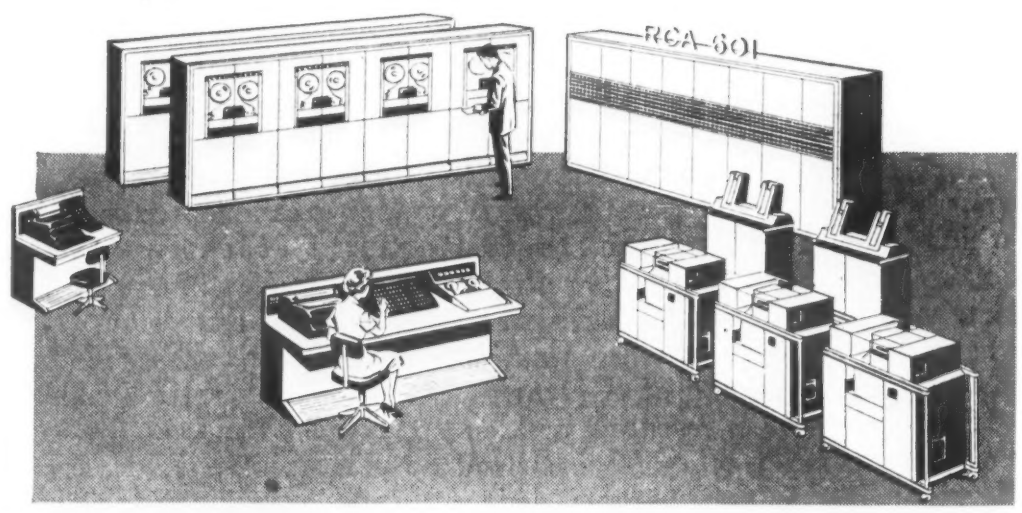


COMPLETE, Compact EDP System at Low Cost... with Optimum WorkPower and Speed

- DATA STORAGE OPTION: magnetic tape or new design discs that switch easily for changing jobs—23 million character capacity
- HIGH VERSATILITY: paper tape, magnetic tape, punch card, *or combinations*, for input-output
- GREATEST CAPACITY, fastest core memory in price class—20,000 character storage; 7 millionths of a second access time; variable word length
- FULL SPEED—reads 600 cards/minute; prints 900 numeric or 600 alpha numeric lines per minute
- AUXILIARY ROLE—feeder or extender to 501 or 601 EDP Systems
- SIMULTANEITY OPTION permits large increase in workpower

For Large Business or Scientific Operations

THE NEW RCA 601



TREMENDOUS WorkPower . . . in Every Field of Data Processing . . . with Previously Unattainable CAPACITY—EXPANSIBILITY—ECONOMY

- ULTRA-FAST—to 180,000 digits/second with magnetic tape
- EXCEPTIONAL COMPUTING SPEED, 1.5 millionths of a second "add" time, 1.5 millionths of a second memory access time
- PARALLEL PROCESSING permits handling a multiplicity of independent programs with changeable priority
- UNPRECEDENTED COMPATIBILITY—with RCA data processing and communications equipment and other processors
- OMNI-CHANNEL INPUT/OUTPUT permits transfer of information to and from as many as 64 sources, with concurrent computing

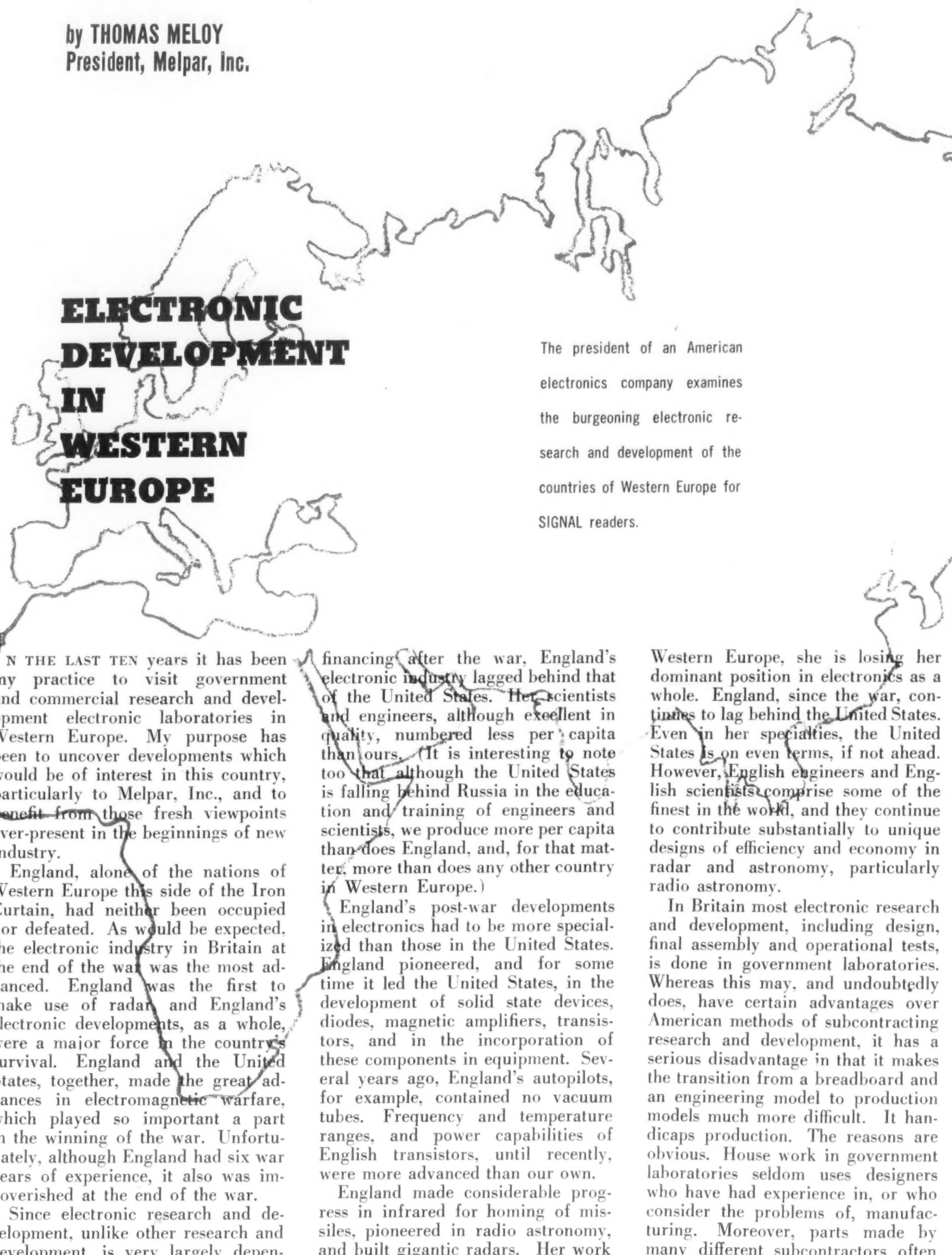
For information write: Electronic Data Processing Division, Radio Corporation of America, Camden 2, New Jersey.

RCA

The Most Trusted Name in Electronics

RADIO CORPORATION OF AMERICA

by THOMAS MELOY
President, Melpar, Inc.



ELECTRONIC DEVELOPMENT IN WESTERN EUROPE

The president of an American electronics company examines the burgeoning electronic research and development of the countries of Western Europe for SIGNAL readers.

IN THE LAST TEN years it has been my practice to visit government and commercial research and development electronic laboratories in Western Europe. My purpose has been to uncover developments which would be of interest in this country, particularly to Melpar, Inc., and to benefit from those fresh viewpoints ever-present in the beginnings of new industry.

England, alone of the nations of Western Europe this side of the Iron Curtain, had neither been occupied nor defeated. As would be expected, the electronic industry in Britain at the end of the war was the most advanced. England was the first to make use of radar, and England's electronic developments, as a whole, were a major force in the country's survival. England and the United States, together, made the great advances in electromagnetic warfare, which played so important a part in the winning of the war. Unfortunately, although England had six war years of experience, it also was impoverished at the end of the war.

Since electronic research and development, unlike other research and development, is very largely dependent upon government support, such innovations as radio, radar, sonar, computers, television, etc., have resulted primarily from government-financed military projects.

Therefore, because of inadequate financing after the war, England's electronic industry lagged behind that of the United States. Her scientists and engineers, although excellent in quality, numbered less per capita than ours. (It is interesting to note too that although the United States is falling behind Russia in the education and training of engineers and scientists, we produce more per capita than does England, and, for that matter, more than does any other country in Western Europe.)

England's post-war developments in electronics had to be more specialized than those in the United States. England pioneered, and for some time it led the United States, in the development of solid state devices, diodes, magnetic amplifiers, transistors, and in the incorporation of these components in equipment. Several years ago, England's autopilots, for example, contained no vacuum tubes. Frequency and temperature ranges, and power capabilities of English transistors, until recently, were more advanced than our own.

England made considerable progress in infrared for homing of missiles, pioneered in radio astronomy, and built gigantic radars. Her work in analysis, data processing, communications, and in spectrographic instruments progressed rapidly. Today, however, although England can still be considered to have the most advanced systems development in Western Europe, she is losing her dominant position in electronics as a whole. England, since the war, continues to lag behind the United States. Even in her specialties, the United States is on even terms, if not ahead. However, English engineers and English scientists comprise some of the finest in the world, and they continue to contribute substantially to unique designs of efficiency and economy in radar and astronomy, particularly radio astronomy.

In Britain most electronic research and development, including design, final assembly and operational tests, is done in government laboratories. Whereas this may, and undoubtedly does, have certain advantages over American methods of subcontracting research and development, it has a serious disadvantage in that it makes the transition from a breadboard and an engineering model to production models much more difficult. It handicaps production. The reasons are obvious. House work in government laboratories seldom uses designers who have had experience in, or who consider the problems of, manufacturing. Moreover, parts made by many different subcontractors often are incompatible.

There is also the difference between the sometimes leisurely scientific pace of the English government laboratory and the profit motives of commercial laboratories. Government

laboratories produce better models, but they generally tend to become more and more expensive.

Germany

During the war, Germany, like England, engaged in intense developments for electromagnetic warfare. However, in defeat, development stopped abruptly when Germany was stripped of her equipment. Many of her scientists were taken to Russia, to Free Europe, or to the United States. It was not until the fifties that Germany again began to devote a major effort to electronics at any increasing rate. Today, with the possible exception of Japan, Germany's component development is equal to that of any country in the world.

As was to be expected, Germany developed components primarily, and concentrated her efforts on such commercial items as business machines, recorders, dictating machines, radios, television and razors. As Germany gradually emerged as a military member of North Atlantic Treaty Organization (NATO), she was permitted to engage in systems thinking and systems design. However, the German electronics industry is still largely dependent on systems developed in the United States, just as it is upon missiles and airplanes.

Germany is behind England in missiles, astronomy, and satellites, and is only now beginning to do important work in solid state devices and in the peaceful uses of nuclear energy. Present work on special projects, torpedoes, and missiles may ultimately produce important results. Much is being done in Germany in the uses and techniques of dielectric materials and in every phase of electronic development, notably computers, guidance devices, and propagation.

The principal electronics companies in Germany, such as Siemens-Holski, Telefunken, and Lorenz, are making vast strides and will play an increasingly important part in the new space age, and in commercial electronics.

Italy

Italy, in a position comparable to that of Germany, tended to spend relatively more time on the theoretical aspects of electronics and physics rather than on material things.

Electronics in Italy, industrial and academic, in research and in application, is in a state of transition reflecting changes in all aspects of Italy's technical life. These changes have been so rapid that it is worthwhile to devote more time to them. Compared to other major countries of Western Europe, Italy has traditionally been weak in industrial and technological development. However, in the last decades, and particularly since the war, her rate of development has been rapid. In fact, Italy's industrial growth since the war rates second only to that of Germany. This growth has been reflected by great changes in the technological climate and, of course, in electronics. Italy now is the most interesting spot in Europe for new and original approaches to research and development. Therefore, it is important to discuss Italy in more detail.

Traditionally, the Italian university professor has operated with great autonomy, having his own laboratory, his own assistants, and his own area of research. As such, whether his work were good or bad, it was his own, individually, and he did not collaborate with other senior scientists. This led to some very good work of a highly specialized nature. But almost no research was produced in system design or in disciplines where the union of the experimentalist, the physicist, the theoretician, and the engineer was necessary. Limitation was placed on the possibility of advancement for the younger scientist, since the number of professors was limited and the lower academic ranks had almost no freedom. Thus, many of the younger scientists have left Italy to work in other countries.

Italian industry reflects this situation. Industrial secrecy is something of a fetish. In fact, in Italy a violation of industrial secrecy by an employee is not only the subject of a possible civil action for damages, but is also a crime punishable under the criminal code.

Because of the lack of research groups suited to industrial problems, as well as the relative smallness of Italian industry, industrial research has been almost completely ignored. Italian industry traditionally has bought know-how and the rights to new products and processes from other countries, and produced very few new ideas internally.

This situation is now changing rapidly under several influences. The growing industrialization of the country is creating a research market within Italy. Perhaps more important, however, has been the internationalization of science which, since the war, has opened the minds of many Italians to the limitations of their traditional methods. Thus, there is gradually coming to age a new generation of professors who realize the advantages of working together. Well trained Italian students are finding opportunities to pursue interesting work in their own country.

On the one hand, there are a larger number of research institutes, such as the Microwave Center at Florence, where numbers of scientists are working together within a technical area, instead of working within "a professor's laboratory." On the other hand, companies such as Olivetti, Fiat, Magneti-Marelli, and others I have visited are beginning to support internal research groups, and to encourage and assist the academic scientists.

A factor in the improvement of Italian research is the support by American agencies. This support has been important both financially (Italy's government budget for research is still relatively low), and educationally, since the methods of other countries are introduced to Italian scientists.

For transistors and solid-state devices, Italian industry must still go to other countries. Her large electronic industries are only now beginning to employ them in routine fashion. On the other hand, the smaller research companies which are developing modern systems, particularly for military use, employ transistors extensively and well. Olivetti is establishing a company to manufacture transistors. This will be the first break-through in the transistor field.

Small groups are working in Turin, Milan, and in Rome on physics and engineering applications of all sorts of solid-state devices.

The use of computers for business purposes is becoming common in Italy, and there are about four computer installations for scientific applications in universities. However, these are machines bought from other countries, notably the United States and France. At the University of Bologna, a highly talented group of engineers are just finishing the construction of a large, very high speed digital computer which will be used for scientific work of all sorts. This machine embodies the most modern developments, both in logical design and construction, and it may be the forerunner of a true Italian contribution to computer design.

In the production of standard electronic test and research instrumentation, Italy has done very little because its industrial demands had not been great enough to support an instrument industry. However, increasing industrialization, and the European Common Market are changing this situation. In certain areas, such

(*Continued on page* 64)

COME TO WESTINGHOUSE!

SILICON RECTIFIERS

		P.R.V.	Max. DC Current at T°C Resistive Load	Max. One Cycle 60 C.P.S. Surge Full Load	Max. Rev. Peak Current @ Max. Temp. & P.I.V.
LOW POWER RECT.	1N1217 SERIES	50-1000 V.	500 MA @ 110°C. AMB.	15 AMPS.	1.5 MA @ 150°C. JUNCTION
	1N1227 SERIES	50-1000 V.	1.6 A @ 140°C. CASE	15 AMPS.	
MEDIUM POWER RECT.	1N1341 SERIES	50-600 V.	6 A @ 150°C. CASE	160 AMPS.	10 MA @ 190°C. JUNCTION
	1N1199 SERIES	50-600 V.	12 A @ 150°C. CASE	200 AMPS.	
	1N1191 SERIES	50-600 V.	18 A @ 140°C. CASE	220 AMPS.	
	1N1183 SERIES	50-600 V.	35 A @ 140°C. CASE	220 AMPS.	
HIGH POWER RECT.	1N1396 SERIES	50-500 V.	70 A @ 150°C. CASE	1200 AMPS.	30 MA @ 190°C. JUNCTION
	1N1660 SERIES	50-500 V.	160 A @ 125°C. CASE	2000 AMPS.	40 MA @ 190°C. JUNCTION
	1N1670 SERIES	50-500 V.	240 A @ 125°C. CASE	3000 AMPS.	50 MA @ 190°C. JUNCTION
	439 SERIES	50-600 V.	240 A @ 125°C. CASE	3000 AMPS.	

GERMANIUM TRANSISTORS

	Class	Typical Operation			Maximum Ratings			
		I_{CBO} μa	h_{FE}	f mc/s	V_{CE} V	I_C ma	P_C mw	T_J °C
2N59	AUDIO-PNP	10	100	1.2	20	200	180	85
2N60	AUDIO-PNP	10	70	1.1	20	200	180	85
2N403	AUDIO-PNP	10	33	0.85	20	200	180	85
2N614	IF -PNP	3	5	3	20	150	125	85
2N616	IF -PNP	3	20	9	20	150	125	85
2N617	IF -PNP	3	14	7	20	150	125	85

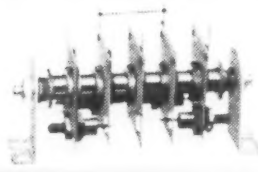
SILICON POWER TRANSISTORS

	Type	h_{fe} or h_{FE}	$f_{\alpha mc}$	V_{CEX} Volts	I_C Amps	T_J °C
2N1015 SERIES—2 AMP.	NPN	10 (V_{CE}=4 V I_C=2 A)	ALPHA CUTOFF .300	30-200	7.5a	150
2N1016 SERIES—5 AMP.	NPN	10 (V_{CE}=4 V I_C=5 A)	ALPHA CUTOFF .300	30-200	7.5a	150

50 AMPERE SILICON "TRINISTOR"* CONTROLLED RECTIFIER

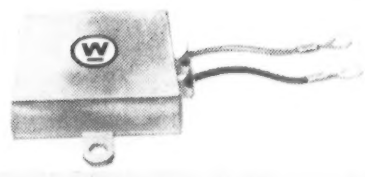
Breakover Voltage @ 125°C T_J	Reverse Blocking Voltage @ 125°C T_J	Turn-on Time	Turn-off Time
TYPICAL			
50-200 VOLTS	50-200 VOLTS	1.0 μ SEC.	15-20 μ SEC.

RECTIFIER ASSEMBLIES



Standard rectifier assemblies are available in all types of circuit configurations, and are designed for either forced air or natural convection cooling with a wide range of ratings. Nickel-plated copper plates and other materials used in these assemblies have been chosen to insure satisfactory performance in corrosive atmospheres and high ambient temperatures.

THERMOELECTRIC COOLING DEVICES



Two types are available in commercial quantities: WX814 (2.5 oz.) and WX816 (3.0 oz.). Both types measure about an inch and a half square and will find immediate application in cooling germanium transistors, infrared detectors, optical systems, mechanical and electric instruments, laboratory and portable medical equipment, and related fields where spot cooling below ambient is necessary.

INFRARED DETECTORS

Type	Noise Equivalent Power (NEP) Watts		Wave-length Response, Microns	Time Constant, μ SEC.	
	TYPICAL	LIMIT		TYPICAL	LIMIT
812	$5x10^{-11}$	10^{-10} MAX.	1-12	0.1	0.2 MAX.

The types listed are just a small sampling of the complete line which can be supplied in volume quantities for prompt deliveries.

When it comes to SEMICONDUCTORS

For the most **complete** line of solid state devices...

● Westinghouse has perfected the widest selection of rectifiers, transistors, and special semiconductor devices available in the industry. In Silicon power rectifiers, Westinghouse is the acknowledged leader in the field.

For the most **dependable** semiconductor devices...

● Every Westinghouse semiconductor device has been carefully designed, manufactured, and thoroughly tested to assure long life, high reliability, and excellent stability.

For **true voltage ratings** in silicon power transistors...

● Only Westinghouse 2N1015 and 2N1016 silicon power transistors offer *true* voltage ratings, guaranteed by 100% power testing—means they may be operated continuously at the V_{CE} listed provided the power dissipation of the transistor is not exceeded. Other conventional power transistors derate the V_{CE} voltage under comparable conditions.

For **new and unusual ideas** in semiconductors...

● Westinghouse is constantly pioneering in exciting new semiconductor devices. Among the latest: a new 50 ampere "TRINISTOR"* controlled rectifier; new thermoelectric cooling devices; an extremely rapid and sensitive infrared detector.

For quality, reliability, performance, and availability...

● Come to *Westinghouse!* For more information call your Westinghouse representative, or write directly to Westinghouse Electric Corp., Semiconductor Department, Youngwood, Pa.

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*Westinghouse Trademark

Westinghouse Semiconductor Department, Youngwood, Pa.

the changing

by BRIG. GEN. W. WALTER WATTS, USAR

FEW PEOPLE CAN recall the exact moment when the course of their career was fixed. I can and vividly. It was on a Yuletide trip in Chicago in 1911. I had already gone through the Meccano and Lionel train stage, and was now what you might call bicycle-gadget crazy. My mission was new handle grips, a luggage rack, parking stand, mud guard and perhaps a new bell. On the elevator was a youngster from a higher grade in my grammar school. He asked where we were going. I explained our mission. "What do you want that stuff for?" he demanded. "Why don't you get Wireless?"

My answer was to ask what he meant. His almost unbelievable explanation of the sending of signals through the air followed. Of course, I had heard that such a thing existed —but only for the Army, the Navy and Signor Marconi. Certainly not for use by a ten-year-old boy. Fantastic!

Well, that day we visited Marshall Fields & Co. The result: Adams Morgan Loose Coupler—Universal Crystal Detector, with one hunk each of galena and silicon—Mesco phones, and a roll of aluminum wire. My receiver was built, installed and operating shortly after Christmas.

Then came April 1912. The sinking of the *Titanic*. And, because of its vital role in that sea disaster, wireless got the greatest press of any event up till that time. Who was the proud authority in my classroom? I was. Little did I know then that I would one day work for David Sarnoff (Chairman of the Board, Radio Corporation of America), the Marconi operator who singlehandedly transcribed the names of the *Titanic's* survivors, and made history at the shore end of that communications epic.

Now as to my subject, "The Changing Shape of Electronics." Let's begin with me. My shape has undergone an enormous change since 1912. I've been *deminiaturized*, or *monsterized*, if there are such words. It's a cinch that my physical aspect hasn't kept pace with the electronics industry's big trend toward the diminutive. Things in our business seem to get smaller and smaller—shrinking the size of components and products while increasing performance capabilities *to a point where we soon may be accomplishing everything with nothing!*

This, of course, is "slightly exaggerated"—as Mark Twain once labelled the premature notice of his demise.

But the solid fact remains that people in the know in electronics aren't the least surprised these days when our industry comes out with a tiny new solid state device—no bigger than the head of a match—having the ability to perform miracles as an active circuit component. We call this device a tunnel diode. Combining high operating speed, extreme ruggedness and versatility, it has a vast potential in ultra-high-speed computers and in space electronic systems. In spite of its smallness, it completes its functions 100 times faster than a transistor.

But RCA and others have smaller wonders. For instance, there is an RCA integrated logic element so compact that 100,000,000 of them might be crammed into a cubic foot. Consisting of a small piece of silicon grooved to form several transistor-like parts that work in unison, it is so diminutive that it can pass through the eye of a standard sewing needle. Yet put together in various arrangements, such elements may perform all basic computer functions of calculating, sorting, "remembering," and controlling flow of information. This is believed by our scientists to be an important step toward the ultimate goal of computer components as compact as those of the human brain.

I cite these two examples to illustrate the vast changes in the size and shape of electronics that are taking place. At RCA, for example, fully 80 percent of today's products and services did not exist commercially fourteen years ago. And it is believed that ten or fifteen years from now, an equally high percentage of products and services will be those not available today.

Because of the broadness of the electronics field, volumes could be written about the changes which are taking place within the field. To be more specific, I have decided to direct attention primarily to the changes in basic components—the real building blocks of basic circuitry which will make possible the products and services of today, tomorrow and ten years hence.

The Transistor

The major change in components —and in a large section of electronics, as well—began on a memorable day back in 1948 when science brought forth an odd-looking little device known as a transistor, with the ability to do many of the things done previously only by electron tubes.

While there was not much fanfare when it reached the industry, the tiny transistor soon became influential in reshaping the components field, and marked the beginning of new and far-reaching developments in electronics.

Transistors and kindred semiconductors opened the way for a vast new array of instruments and devices in advanced electronics, and hastened development of new technologies for defense, industry and consumer products.

Teamed with other areas of progress, semiconductors gave a big push not only to the components business, but to the whole electronics industry, which for many years previously had been finding its main market in radios, television sets and phonographs. Now, spurred by the computer, and space and missile race, new and growing markets for electronics have created requirements for components of almost infinite variety.

Advances have been accelerated by the trend to smallness—so important in military communications, defense and space systems.

In the race to shrink size and weight, a significant jump ahead has

been achieved with the micromodule concept—a joint project of the Signal Corps with RCA as prime contractor. This advance provides electronics with a new dimension—a revolutionary space-saving concept that combines vital elements of uniform size and shape into one simple unit. This unit, or module, can be built to function as an amplifier, oscillator, converter, mixer, filter and the like, to meet the specified needs in electronic circuit design.

By combining our micromodule concept with existing techniques in miniaturization, we can reduce many military items to one-tenth—and in some cases to as little as one-thousandth—their present bulk, with corresponding weight reduction.

Experimental circuits, including entire assembles, wiring and other elements, have been compressed into micromodules no bigger than a cough drop.

In comparison with integrated circuits or molectronics, the micromodule concept has many advantages. It can be adapted to almost any solid state device, present or future, without modifications. It can accommodate a wide variety of materials in its structure. Its individual components can be combined with solid state devices in a common structure as rapidly as integrated circuitry or molectronic elements become available. It can be used in all low-power transistor stages, thereby encompassing the majority of today's military and commercial circuits. Its assembly of individual elements into a module permits development of circuitry in the proved and tried "breadboard" method. The circuit engineer can still tailor his components to meet his exact requirements. This is not true of solid state circuitry which requires that all work be done as a coordinated effort under one roof.

This requirement takes the circuit development responsibility away from the end equipment designer and puts it into the hands of the manufacturer of the solid state device.

Let me ask you to do some thinking about one of the problems faced by the molectronic approach. The industry has been making transistors for more than ten years. All manufacturers will agree that as an average we're still scrapping 40% of our entire production because of our inability to control the actions of electrons in solids. In some difficult military transistors, scrap runs as high as 60 to 70%.

Now let's assume your solid state device representing six or more circuit elements mixed up in a "witch's brew" follows the traditional reject or failure patterns we have learned to expect in transistor production.

If you are lucky, five per cent of your starts may be usable devices. That is economically intolerable. Now don't get me wrong. I believe in integrated circuitry. I believe we will learn, in time, to equal or surpass the yields of the individual component approach, but there is a long and costly road to travel before we can afford the price of integrated circuitry in any but the most sophisticated gear such as missiles.

Now what about the cost future of micromodules? Based on comparable production volume it will be less costly than current circuitry. Detailed study of material costs, processing costs, assembly costs and mechanization programs indicate that micromodules will equal current printed circuit costs on a volume of only 5,000,000 modules. Why do I say only 5,000,000? If you take each block on a block diagram to which micromodules apply across the industry and multiply that by the number of equipments to be produced, you reach a staggering total potential for micromodules of nearly 100,000,000. And this is only for military equipment. If micromodules can equal current costs on a 5,000,000 volume, you know as well as I do what can happen to costs if volume is multiplied by 2, 4 or 10 times. At that point TV and radio will reap the benefit of this new approach. And then comes pocket-size single sideband (SSB) gear.

To assist end equipment manufacturers and circuit engineers to become familiar with the application of micromodules to new equipment designs, RCA had developed a basic micromodule laboratory kit (BML) to enable the equipment manufacturer to design, build and test experimental micromodules in the privacy of his own laboratory.

This BML kit, as it's known, includes all tools, jigs, fixtures, materials, micro-elements of all basic types designed especially to meet experimental requirements. Moreover, through a unique approach to the design of micro-elements in the kit, parts with multiple termination patterns can be modified to a single desired pattern and electrical value by abrasion techniques. This provides a high degree of assembly flexibility. Those of us familiar with the micromodule concept believe that the BML kit represents a tremendous advance in the easy application of micromodules to equipment designs.

Fourth Dimension

The changing shape of electronics has several dimensions. We've talked about the Size, the Weight and the Speed of Performance of the New Electronics. There is a fourth dimension (apologies to Einstein) which I shall call Time. We are using the first three dimensions to increase our capability on every front—but we are failing miserably in one area to apply fully the advances of our own creation. I am speaking about test procedures and systems check-out.

With a dozen or more black boxes in a chain, or equivalent circuitry in a single unit, we are still too often pursuing the archaic circuit-by-circuit test that is largely manual and very time-consuming. We can no longer spare or afford the time. By using the most modern methods, we can cut the time to a fraction, cut the skills required, reduce the total number of personnel and improve the effectiveness of our tests.

By the use of advanced computing techniques, utilizing magnetic and paper tape, we can simulate any oper-

shape of electronics

General Watts is Group Executive Vice President, Radio Corporation of America.

ating situation. By proper programming, we can quickly subject the entire system sequentially to a complete test of each individual circuit and the system as a whole.

We can get fast printed answers that show fault points accurately and print out repair instructions. Such digital evaluation equipment is now in being for certain missile programs, and even includes the part numbers.

But it is now possible to build universal test sets based on these principles that can handle any complex electronic gear.

To utilize fully such test equipment the end equipment to be tested must have adequate access points. Most current gear can be tested through its connecting cables.

Fortunately, modular construction, conventional or micromodule, is most easily adapted to this application since modular units provide the input and output access points required. Throw away or replaceable module maintenance philosophies are wholly compatible with this concept.

By programming on tape the test procedures for a large number of equipments and using truck-mounted or helicopter transported test sets, rapid system evaluation is provided with one single test set.

As an example of the performance compared with conventional methods, here are some figures taken from actual equipment checks: *Manpower* —current method, twelve men; digital method, four men. *Skills required* —current method, eight technicians with high skill levels, four with medium; digital method, two medium skill, two low skill technicians. *Time factor*—current method, one hour and a half; digital method, ten minutes. Here is the important point. The universal test set eliminates the need for complete engineering and production of special test equipment for each new equipment or system. All that is required when a new equipment is introduced into the field is the development of a test program and the creation of a magnetic tape.

Electron Tubes

Until only a few years ago, the electron tube was the dominant force in the transformation of our industry from a single product to a multi-directioned enterprise. It was the heart of radio and television circuits, phonograph recording systems, international radio communications, and talking motion pictures.

Everyone has had more than a passing acquaintanceship with the electron tube. We have seen it in many shapes and sizes in the past. We will see more of it in the future.

For, despite the seemingly wondrous performance of semiconductors and other up and coming devices, the electron tube not only continues to play an immensely important role in this rapidly advancing art and science, but promises to remain a vital factor as time goes on.

Every time an intercontinental ballistic missile blasts off from the Air Force Missile Test Center at Cape Canaveral, Florida, scores of electron tubes pulse inside the big "bird," and help to control its flight and send messages back to earth. Moreover, thousands of other tubes glow on the ground base, and on island watching-posts, that stretch 5,000 miles down range.

Radar tubes help track the flight. Other types are essential to communications, timing and telemetering systems which record flight data.

Now, it is my privilege to announce that when Pioneer V was blasted into space from Cape Canaveral in March, RCA electron tubes played a key role in the first stage of the rocket that sent this historic satellite toward its orbital path with the sun.

Almost from the moment that it began curving upward, Pioneer V emitted radio signals that gave U. S. scientists technical reports on cosmic rays, radiation and other conditions in its pathway—data expected to answer key questions to enable the U. S. to put a man safely into space.

At tracking and triggering stations on the ground in England and Hawaii RCA electron tubes are performing vital control functions as Pioneer V hurtles on toward its extraordinary rendezvous. Each time buttons are pushed to bring in the satellite's signals, these ceramic-metal tubes go into action.

On the satellite itself are RCA power tubes used to operate a 150-watt radio transmitter which will take over shortly when the 5-watt signal source reaches a point beyond its power range. The larger transmitter will begin sending audible reports to earth when Pioneer V reaches a distance of eight to ten million miles. This transmitter is designed to work indefinitely, and scientists hope that it will still be transmitting in 1963 when Pioneer V will again overtake the earth and come within a 50-million-mile reception range. (See Pioneer V article, page 42.)

This satellite story illustrates dramatically how very important electron tubes are in the conquest of space. They remain equally important in defense, in industry and in the home as well.

One of the most exciting recent developments is a revolutionary electron tube design, which we call the "Nuvistor."

This thimble-size tube has been hailed by engineers as a truly significant advance in electronics. They believe that features inherent in the Nuvistor design are destined to change our thinking about the choice of electronic components, particularly where improved reliability, improved efficiency, small size and low-power drain and high frequency are important factors.

Engineers familiar with the Nuvistor foresee for it service lifetimes of tens or even hundreds of thousands of hours.

At the end of 1959, nine months after its development was announced, more than 250 manufacturers of electronic equipment were evaluating prototypes of this tube for use in TV sets and communications receivers, as well as a wide range of products for defense and industry. The first Nuvistor triode is now in commercial production.

Successful tests have recently been completed on a super-power tube, about the size of a nail keg, which is thought to be the most powerful tube ever built. It is capable of producing up to five million peak watts of long pulse power. This offers a potential of delivering sufficient power to explore the possibilities of outer space communications, intercontinental televison, and radar on a global basis.

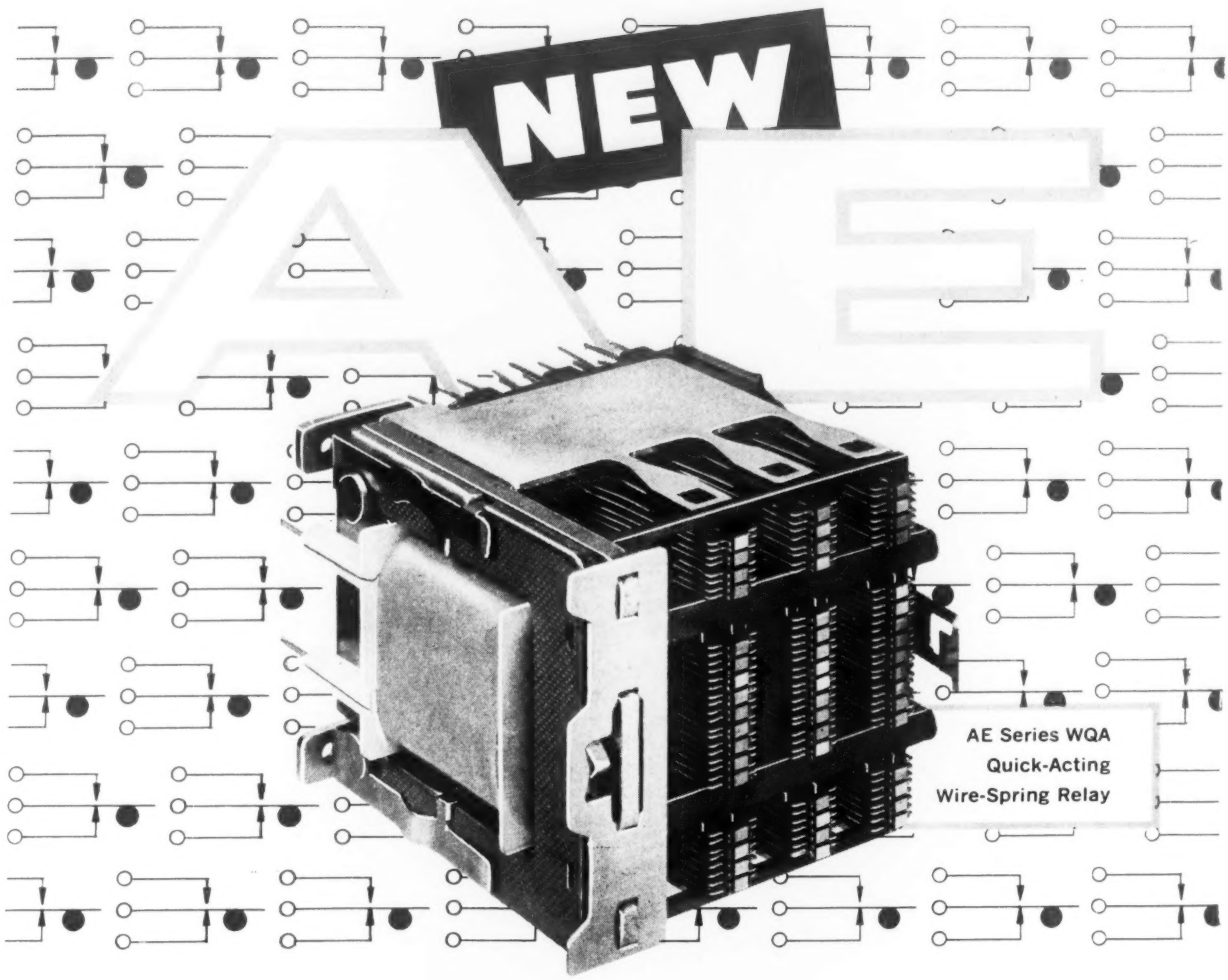
Under the acceleration of defense and industry needs, new tube developments of almost unbelievable variety continue to multiply. An estimated 432,000,000 receiving tubes of many types and 13,100,000 TV picture tubes were produced in 1959. In 1957, RCA turned out its two billionth electron tube; and a little over a year ago, we produced our 20 millionth black-and-white TV picture tube.

If you get the impression from these figures that electron tubes are still very much with us, despite the boom in semiconductors, you are most certainly right. Moreover, it's my firm conviction that tubes will continue to grow in importance, regardless of the changing shape they and the electronics industry take in the years ahead.

"Rebirth of Communications"

Another change of major significance is taking place in the shape of electronics. I call it the "rebirth of communications." Coming out of World War II glamorization of some of the new techniques and discoveries

(*Continued on page* 66)



TO THE ENGINEER

who wants to transfer 51 circuits simultaneously

If you need simultaneous transfer of a large number of circuits without fail, take a look at AE's new WQA relay. It will do the work of four or more heavy-duty, general-purpose relays each with maximum spring pile-ups, and sustain 50 million or more operations without readjustment.

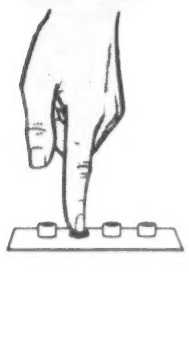
In the WQA relay, all moving springs pass through holes in a unique actuating "card." Moved directly by the armature, the card in turn actuates all the moving springs. This method of operation pre-establishes exact timing and sequence of all spring operations, and at the same time assures perfectly synchronized "break-before-make" on all circuits.

Contact capacities on WQA relays can be custom-tailored to your needs, with either one, two or three levels of contact assemblies available, each with a capacity of 17 Form C combinations. Other Forms available.

Our circuit engineers will be pleased to work with you in adapting the WQA to your specific design. Or, if you wish, they'll take on the complete packaging job.

If you'd like more information on the WQA relay, address your request for Circular 1957 to: Director, Control Equipment Sales, Automatic Electric, Northlake, Illinois.

AE CAN DO



AUTOMATIC ELECTRIC

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

by COL. L. C. SHEETZ, USAF
Chief, Policy Group
Directorate of Communications-Electronics
Headquarters USAF

is communications reliability possible

TODAY IN MILITARY communications we find that we have improved the speed and capacity of our communications systems by several orders of magnitude but have failed to provide the most necessary element—that of reliability. The need for reliability is greater than ever and without it our advances in speed and capacity may be of little significance.

Never was reliability so vital. For years, a 99% efficient circuit was considered to be a sought after goal. Today that 1% outage, amounting as it does to 14.4 minutes per day, is unacceptable. By grim coincidence, this nearly 15 minute outage approximates the count-down time of an ICBM, the length of time it takes to scramble SAC and the amount of warning we can expect from the Ballistic Missile Early Warning System.

There are many reasons why communications fail. Electronic equipment has become so familiar to us all that we tend to forget how remarkable it is that it works at all. The signal levels that must be detected, amplified and put to work, when considered in an absolute sense, are very tiny indeed. Very small variations in the value of a component are often sufficient to cause failure. Moreover, electronic equipment is inherently ill suited to preventive maintenance. Little can be done to anticipate trouble and remedy it before equipment or component failures. Routine replacement is not the answer; certain components, particularly vacuum tubes, are more likely to fail early in their life than they are later. Load conditions are not suitable criteria for reliability; some tubes have better reliability under lighter than rated load, others under full load and some, it appears, are not reliable under any conditions of load. Solid-state techniques show many of the same difficulties. Even if we can correct many of the causes of unreliability that are inherent in the various items of equipment itself, we have only just begun.

If one could look at this problem of reliability from a purely academic point of view, the infinite variety of the ways communications can fail would prove fascinating. Nothing, to the author's knowledge, can fail in such a bewildering variety of fashions. Some of the more bizarre types of communications failures in the author's experience are:

a. The time the sentry, during his long cold tour of duty, built a fire to heat a cup of tea and chose as his location the cable terminal box, thereby burning out the entire transmit side of the keying line. The wetting down the fire department gave the area when the fire got out of hand did not help the rest of the cable.

b. The time a schizophrenic in the relay station received a "personal from _____ to _____" message (from a Major Air Command commander to one of his Air Force commanders) and tore up the message tape and threw it into the waste basket. The medics said later this was a typical behavior pattern.

c. The time the microwave engineers, having a greater knowledge of electronics than forestry, neglected to allow for the fact that a eucalyptus tree grows 9 feet a year. In two years, the 18 feet of clearance allowed for a line-of-sight shot no longer existed.

Any experienced communicator can attest to the credibility of the above experiences and probably could add several more weird ones of his own. Fascinating as this subject may be, it still adds up to unreliable communications.

Even the Continental United States has reliability problems. One Major Air Command found in a series of tests of its alerting system, a system which had direct lines to each of its bases in the U. S., that the entire system functioned perfectly only 7% of the time. In other words, 93% of the time they failed to raise one or more of their subordinate bases because of communications failure. They subsequently had their system re-engineered to provide an automatic checkout system which provided an alarm when one or more bases was out of contact. It is interesting to note that this system did not basically provide greater reliability; it simply warned of an outage as soon as it happened and permitted maintenance action at once. From the experience of other ZI commands, the experience of this one command was in no way unique.

We are all familiar with the efficiency and reliability of the Transatlantic cable system when it is operating. However, between 1 December 1959 and 1 February 1960, there were 12 cable breaks in the Atlantic including one of the coaxial telephone cable. Also, even the highly engineered, repeatedly checked circuitry provided by the Air Force Command Post to alert the unified and specified commanders has its share of outage, as anyone who uses it regularly can testify.

No one familiar with high frequency radio needs to be reminded of the vagaries of the ionosphere, particularly over northern paths. VLF and LF are not subject to the same degree to propagation difficulties, but in areas of high ambient atmospheric noise they are unreliable if not completely unworkable. Moreover, the size requirements for VLF and LF antennas are prohibitive for many military applications.

Scatter communications of various

kinds have been advanced as a solution to the problem; it is true that they have represented a significant improvement. Tropospheric scatter, in particular, has provided us quite satisfactory links. The problem here is that the maximum range of the technique requires a number of links connected in a series if any distance is to be covered. The over-all reliability of the system then represents the product of the reliability of the individual links (three 90% efficient links in the series adds up to an over-all system reliability of approximately 73%). Although most tropo links in themselves have a high reliability, any failure of one link brings the whole system down. Additionally, tropo scatter antennas are vulnerable to icing and wind damage. Ionospheric scatter runs into frequency problems and into various forms of unusual interference such as anomalous propagation from instant interference sources not to mention "back scatter."

Considerable hope has been held out for the use of active or passive man-made satellites. Even if one ignores the well known reliability problems encountered in placing a satellite in orbit, the active satellites are subject to all the normal component failures, accentuated in this case by the high shock factor encountered in launch and various other forces and radiations induced by their special environment. Passive satellites are less subject to these problems but for most military purposes require far too much in the way of power and antenna gain to be useful.

In all of the above, we must remember that we are only talking about reliability in time of peace. The bull-dozer operator who cut the power line, the trawler operator who caught the submarine cable instead of a flounder and the careless camper who set the forest fire that burned out the Alcan highway cable are not at war with the United States, although there are times when it would probably be difficult to convince the harried communicators of this fact. In addition to all of the acts of God, and the accidental acts of man, in war we must be prepared for deliberate jamming, sabotage, the effects of high altitude nuclear bursts and damage to the installations themselves by enemy action. In short, to the inherently unreliable peace-time system we add a number of powerful factors that tend to reduce the already unacceptably low reliability.

Even, if by some miracle, we were to render our communications impervious to all of the various types of interruptions we have discussed, we still have the problem of people. Although man is probably the best instrument for operating communications systems that can be found, even the most optimistic do not claim infallibility for him. It appears to be a demonstrated fact that we must be content with imperfect people.

In considering all of this, one cannot help but feel that we are up against some law of behavior that is working in its inexorable way to reduce the reliability of our communications. The "Theorum of the Inherent Perversity of the Inanimate Object"* has been blamed. Unquestionably Murphy's Law** is also a factor. Aside from these there must be some other factor that is working against us.

Mathematical Factor

There is, in fact, a readily determined mathematical factor at work. We touched upon it above when we referred to the over-all efficiency of a number of links in series. Simply stated, the probability of a number of events occurring simultaneously, or one after another in series, is the product of their individual probabilities. Hence, the probability of all 3 links being operational when each one individually has a .9 probability of being operational is .9x.9x.9 or .729. As one can readily see, the probability of several events occurring simultaneously is considerably less than the probability of any one of them occurring. Anyone who ever tried to make 8 "the hard way" can attest to this. By their very nature, communications are susceptible to many failures caused by this mathematical principle. It is inexorable and we might as well accept it.

However, having discovered that the mathematics of probability frequently work against us, is there any way of putting them to work on our side? We think that there is. The obvious way to approach this is to put reverse English on the problem to minimize the probability of failure. How do we do this? Simple enough; just design the system so that several routes must fail simultaneously in order to have complete system failure. Let's try 3 circuits again, this time in parallel with each having a probability of .9 of operating. Since the probability of failure is equal to 1 minus the probability of functioning, the former is equal to 1—.9 or .1. If over a given path we have 3 independent routes each having a probability of failure of .1, the probability of system failure is then the probability of the simultaneous failure of all three or .1x.1x.1 or .001; we now have a 99.9% system. This begins to look like we are getting somewhere. In fact, if we have one of our paths a .9 circuit, another a .7 and another a .6, their respective probability of failure being .1x.3x.4, or .012 or a 98.8% probability of successful communications. Even addition of several poor circuits may be well worthwhile in terms of the over-all system reliability gained.

Of course, something that would destroy either terminal would have the effect of nullifying all of the paths but then if the terminal is destroyed there probably would be no one having a need for communications anyway. The only catch in the problem is that the paths must be truly independent so that the same interruption cannot affect more than one. Of course, there are various degrees of independence and any degree of interdependence will tend to reduce the pure probability advantages. However, we should attempt to maximize independent circuitry in all our planning. Provision of multiple media of transmission (HF, cable, scatter, etc.) between the same two points is a good way to do this and can allow system reliability far in excess of that possessed by any one of the media.

In this imperfect world of ours, there seems to be no solution to the problem of providing reliable military communications except through the application of the laws of probability, making maximum use of redundancy and duplication. It is for this reason that we must hold on to some less efficient circuits even after much higher quality facilities are available. Only by providing the maximum number of independent routes between two points can we make probability work for us. We then require the simultaneous failure of many elements before we have total system failure—as we have seen, a very unlikely event.

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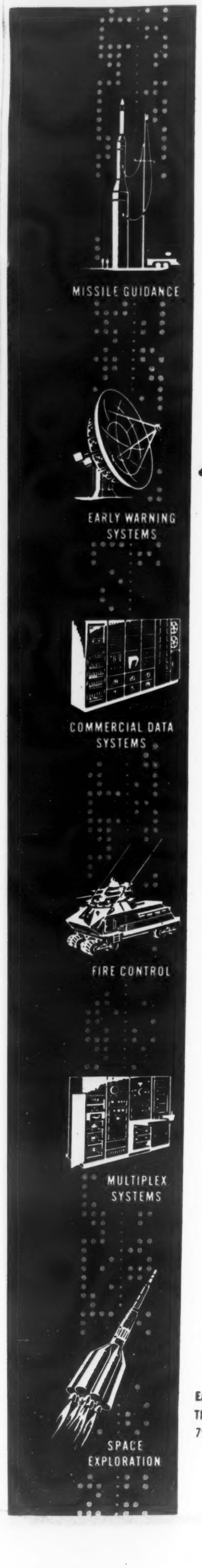
*The theorum advances that inanimate objects inherently behave in a perverse fashion. It is the working of this theorum that causes heads to turn off screws, zippers to jam and windows to stick.

**Murphy's Law is the law advanced by one M/Sgt Murphy, a crew chief of many years experience. He stated "If there is any way a part can be improperly installed, someone will improperly install it." Although originally advanced in connection with aircraft maintenance, subsequent investigations by M/Sgts Shultz, Cohen and Dabnovich have proven its applicability to C-E. The latter, by the way, is the author of the Dabnovich axiom, "If it works, don't fix it." Application of this principle has in some instances reduced outage by as much as 30%.



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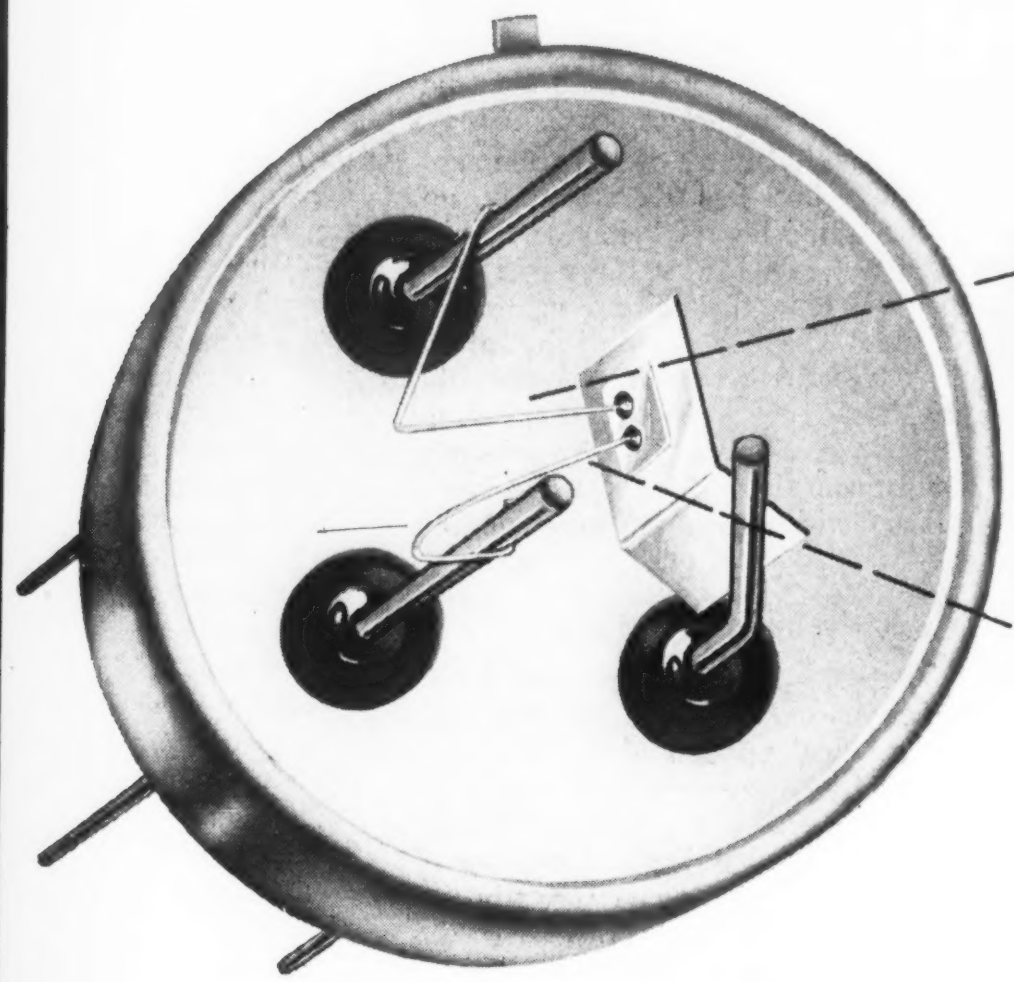

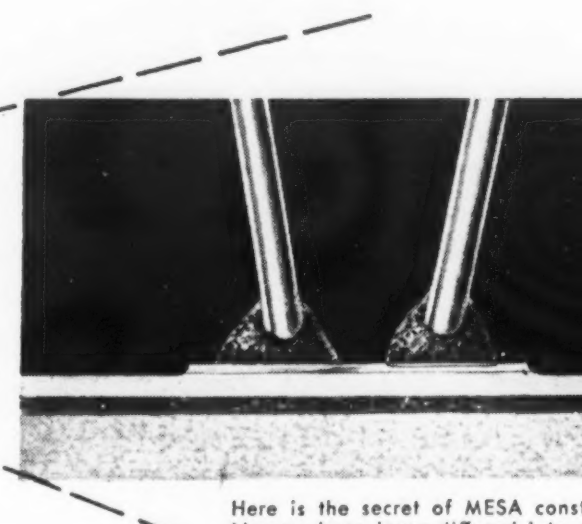

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FACSIMILE today and tomorrow

by A. G. Cooley, Executive Vice President
Research & Development
Westrex Corporation

ONLY A FEW YEARS ago, many people thought facsimile had something to do with a cereal box or a counterfeit dollar bill. Today, facsimile telegraphy, usually referred to as "facsimile," is well recognized as a form of record communications with a promising future, especially since it is to be given an opportunity to compete with railroads and airplanes in moving the mail.

There is some confusion as to the scope of facsimile. Some are of the opinion that it refers only to black and white recording; others have the feeling it refers only to electrolytic recording. The definition of facsimile includes nearly all forms of picture or graphic transmission whether it be black and white or photographic. Facsimile encompasses wire photo, radio photo, sound photo, photo fax, weather fax, telephoto, etc.

It cannot be said that facsimile has "arrived" until it is responsible for the movement of a much larger percentage of the message traffic than it is today. In reaching its present status, many failures have been left by the wayside since the construction of the first machine over a century ago. The first signs of permanent success appeared when Radio Corporation of America established an overseas radiophoto service in 1924 and American Telephone & Telegraph Co. established a telephoto service in the following year. The news picture services were the prime support for facsimile until the end of World War II.

The first serious application the military had for facsimile equipment purchased by the Signal Corps during the war was the transmission of weather maps from Washington, D. C. to Presque Isle, Maine, the jumping-off point for the bombers ferried to Europe. This equipment, the FX-1 was a re-hash of the facsimile designed for the news photo division of *The New York Times*. The copy size was 7 x 8 inches. Only one-fourth of a weather map could be transmitted at a time. The need for a larger machine resulted in the AN/TXC-1 which handled maps having a size of 12 x 18 inches.

The AN/TXC-1 served a very useful purpose in the European Theatre during the war. General Donald Yates, USAF, who was responsible for the utilization of facsimile by the Air Weather Service, brought his equipment back after the war and set up what seemed to be a very ambitious program of transmitting weather maps to all Air Force installations throughout the Continental United States. A wire-line network was established connecting over 130 air weather offices to a Weather Central in the Weather Bureau in Washington, D. C.

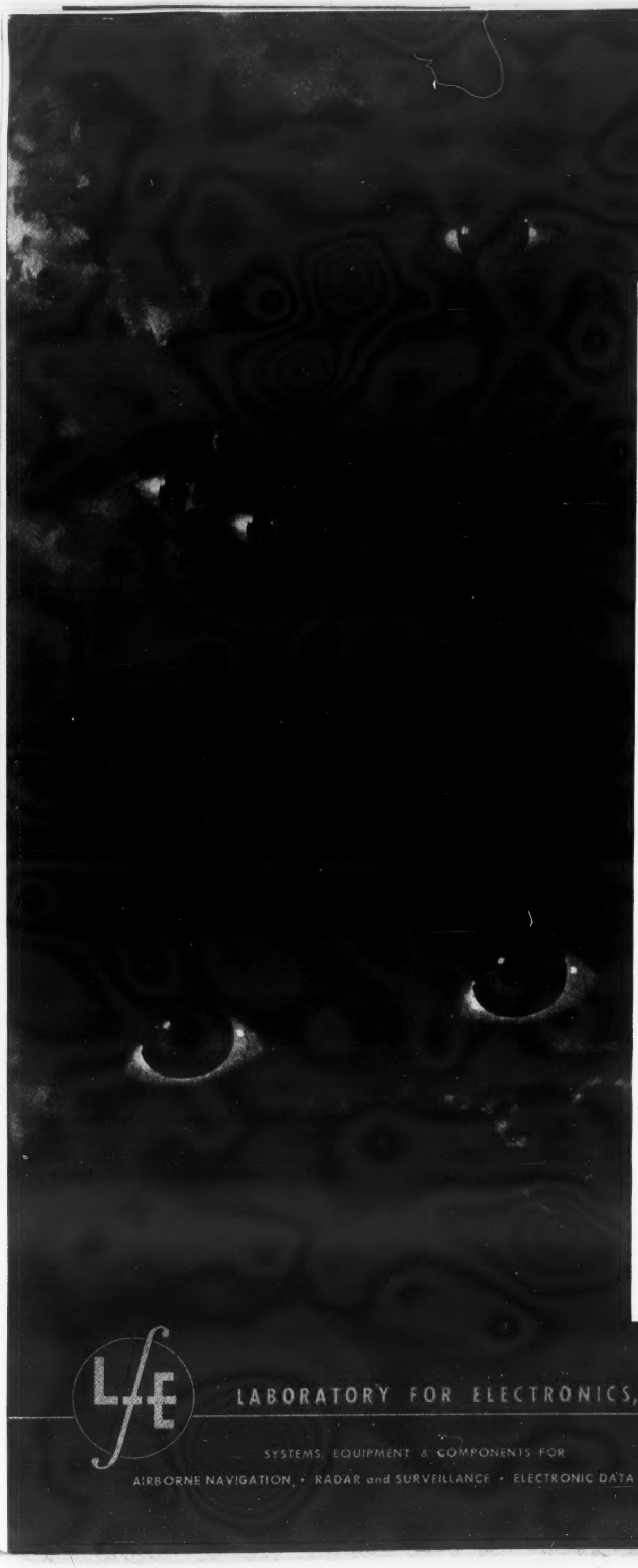
Today, this National Facsimile Network is furnishing more than sixty weather maps daily to over 600 Army, Navy, Air Force, Weather Bureau, air-line and private meteorologist's offices. Before facsimile, as much weather information as possible was transmitted in coded form by printing telegraphy such as Teletype. The meteorologists receiving this information required about two hours to draw up and interpret a complete surface map of the U. S. No two meteorologists arrived at the same interpretation. Flyers making cross-country trips often found quite different maps at various airports that were prepared from the same information transmitted from Washington. The need to know weather and forecasts was best satisfied by facsimile.

Many engineers who worked on facsimile for news and weather services regarded their work merely as stepping stones toward a facsimile system to handle point-to-point message traffic. Western Union lost no time with stepping stones. They leaped directly into facsimile for message communications. Their first message service was between New York City and Buffalo in 1936. Today, they have 35,000 small facsimile sets for transmitting from customers' offices to main offices. These small facsimile sets carry the trademark "Desk Fax." A few hundred facsimile sets of a larger size are in various types of services. In addition to Western Union facsimile operations, message traffic is being handled over phone circuits with equipment manufactured by Stewart Warner, Electronic Communications and Westrex (formerly Times Facsimile Corporation). Facsimile is in regular service in Europe for message traffic.

Newspaper publishers around the world were startled to learn that the delegates to the 1956 Republican Convention in San Francisco received each morning a facsimile edition of *The New York Times*. Except for the absence of advertisements, it was difficult to distinguish the San Francisco edition from the regular New York edition.

The greatest excitement over this accomplishment occurred in the Land of the Rising Sun. Today, the *Tokyo Asahi* is publishing a facsimile newspaper in Saporro in the northern island of Japan. Another newspaper,

(*Continued on page* 37)



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Mainichi Shimbun, has facsimile equipment that is being used for evaluation purposes while awaiting delivery of additional equipment that will be used in publishing in another Japanese city. Equipment is now being installed for the services of a third newspaper, the *Yomiuri Shimbun*.

A brilliant future for pressfacsimile in Japan seems assured. It is quite probable that pressfacsimile will have its place in the magazine and newspaper industry in this country. Transmitting a page of stock market reports by telegraph without an error is close to an impossibility. It is almost an impossibility to produce an error by facsimile without it being obvious.

The transmissions from New York to San Francisco were made over a video circuit at the rate of one page in two minutes. Since that time, equipment has been made to record four times as many elemental areas per second. This means one page could be transmitted in one half minute, if the same number of elemental areas per square inch were transmitted.

The success of high speed pressfacsimile has given encouragement to those who look forward to high speed message or letter facsimile. Techniques needed to make a success of letter facsimile are already known; however, work has to be done to put the hardware in proper form and to tune up the system to meet operating requirements.

The copy must be scanned in the flat, because for the high speeds, it would be impractical to scan a revolving drum. Two forms of flat bed scanners are available. The first form is a flying spot scanner of the cathode ray tube type. A spot is swept across the face of the tube and is projected upon the copy through a lens system. Light projected through transparent copy or reflected from opaque copy is picked up by the photo tube and converted to a signal for transmission. As the spot sweeps across the copy, the copy is moved perpendicularly to the sweep. Such an arrangement was first demonstrated by RCA with their UltraFax system in 1948. The copy was in the form of a 16 millimeter film. A film having a recording of *Gone with the Wind* was transmitted in two minutes and twenty-one seconds. Two years prior to the demonstration in Washington, David Sarnoff, RCA Chairman of the Board, made the prediction. "Future generations, I am sure, will have a radio mail system that will make our present delivery system—splendid as it is—seem as slow as the Pony Express." To photograph the mail on to a film would be costly and cumbersome. The original copy for transmission must be moved by a belt past a scanning beam.

In the second system, the flying spot can be derived from an ordinary incandescent lamp. The sweep of the spot is accomplished by means of a high speed rotating prism. Such a system, the AN/GXC-4, operating at a lower speed was described in the July 1957 issue of SIGNAL.

Both systems accomplish the same results. It is not known at this time which will prove to be the most economical and reliable.

Recording on photographic paper would be too expensive. The use of conventional facsimile recording paper such as electrolytic paper, Timefax and Teledeltos would be prohibitive in cost. Pressure sensitive papers might be used at lower speeds. But in trunk circuits operated at video speeds, it appears that some form of electrostatic recording is the best answer.

Two Systems of Electrostatic Recordings

Electrostatic recording can be in two forms. In the first form, the recording paper is given an electric charge on the surface. The areas which are to appear white are discharged by the light from a cathode ray flying spot recording system. The life of the phosphorous on the face of a cathode ray tube used in this type of service is rather short. The answer to this limitation may be in a new rotating anode type of cathode ray tube developed by CBS Laboratories. It is known as the Line-Scan tube. Instead of the electron beam striking the face of the tube, it strikes the rotating drum that is covered with a phosphorous coating. In this way, the phosphor heating is distributed over the entire drum.

In a second system of electrostatic recording, the record sheet receives a charge from the end of a cathode ray tube in accordance with the beam intensity. The charge is conducted through the glass face of the tube by means of small wires .001 inch in diameter and spaced 250 to the inch. This is known as the Printapix tube manufactured by Litton Industries and is employed in the Video Facsimile System developed by A. B. Dick.

In making a recording from a Printapix tube, ordinary paper can be used to receive the electrostatic charge. The paper is dusted with a powdered ink and developed in the usual way by heating. At the video speeds employed, the problems of inking and fixing by heat have not as yet been solved. A recording paper developed by Burroughs that fixes by pressing the ink into a coating appears promising.

It is apparent that a video speed facsimile system intended for message or letter-type communications can best be engineered around an assembly of techniques developed in the laboratories of many companies.

While the thought of video speed facsimile in various types of services is intriguing, one must not lose sight of the more mundane but very important service facsimile is performing at lower speeds. The Chinese were conservative when they invented the expression, "One picture is worth a thousand words." A thousand words cannot produce the impact that is conveyed in many of the facsimile pictures we see in our daily papers. A thousand words will not tell the story portrayed by most of the weather maps that continually flow from the Weather Central which is now at Suitland, Md. The time to absorb the information which is presented graphically by facsimile is but a fraction of the time required to read and absorb one thousand words.

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ELECTRONIC INSTRUMENTATION FOR FREQUENCY AND TIME

by H. F. HASTINGS, Radio Division, U. S. Naval Research Laboratory

"The demand for ever greater precision and accuracy of frequency and time never ceases."

THE NAVY, because of constant need to rely on clocks for long range navigation and on radio for long distance communication, has always been deeply concerned in the development of precise techniques and devices for accurate generation and determination of frequency and time. The Naval Observatory has been determining time for the United States since the early 1830's. In 1904, the Navy transmitted the first radio time signal. In 1913, the U.S. Naval Radio Station, Arlington, Virginia, began the first regular time broadcasts. These transmissions were received in distant parts of the world, including Europe, as well as in areas close to the United States. In the latter 1920's, the Naval Research Laboratory conducted studies of the international transmission of precision frequency signals at 20 megacycles.

The demand for ever greater precision and accuracy of frequency and time never ceases. Today, microsecond time pulses are used in radar, in precision navigation systems, for velocity measurement and guidance of fast moving aircraft and missiles, and in the rating of ship and shore frequency standards. For instance, for accurate determination of the velocity of a missile along its trajectory, microsecond synchronization of clocks for periods of 24 hours or more at a number of range stations is essential. This means that the standard frequency oscillators used to control the clocks at the various remote points must not vary by more than one cycle in one hundred billion cycles (1 part in 10^{11}) per day.

Similarly, successful operation of suppressed carrier type single sideband communication systems depends on accurate synchronization of precision frequency standards ashore and aboard ship. To assure the necessary minimum allowable accuracy of one cycle in ten million ($1p/10^7$) of transmitter emission and receiver tuning, the standard oscillator used for reference or control in each installation must not deviate from that of any other ship or shore station by more than $1p/10^8$ over a period of 60 days. This assumes that each station will have an opportunity to check and correct its reference oscillator at least once every 60 days against a master standard available on a nation-wide or world-wide basis, and that the individual standard reference oscillators do not drift at an average rate of much more than $1.5p/10^{10}$ per day.

For nearly forty years, the Naval Research Laboratory has been developing new means and techniques for measuring and producing electrical waves of accurate and constant frequency. Through its close cooperation with the Bureau of Ships and many outside contractors in this field, the state of the crystal oscillator art has been advanced to such a degree that naval applications requiring highly precise frequency determination and control, such as suppressed carrier communication and various types of radio navigation, have become feasible. Extra-terrestrial communication and space navigation, among other requirements, will necessitate continuing refinement of existing techniques. In addition, new precision frequency sources, such as those of the atomic type, are being developed for these applications as well as for improvement of existing systems.

Long Distance Frequency Synchronization

In free space and in the earth's atmosphere, radio signals traverse a distance of approximately 186 statute miles in one thousandth of a second.

In one microsecond, the distance is only 0.186 statute mile, or a little less than 1000 feet. If either or both of the radio system's terminals is moving, or if the path taken by the radio wave varies in length from moment to moment for other reasons, it becomes difficult to compare or synchronize frequency standards by radio means, particularly when they are located at widely separated points on the surface of the earth. The cause of the difficulty is doppler shift of the signal frequency. Since the path taken by the waves is certain to vary, really accurate frequency comparison will require long-term observation of the received signal over days, months, and even years, even when both points are fixed in location. In general, 24 hours can be considered as a usable although small sampling period.

Radio time signals can be derived from a synchronous-motor clock which is driven directly by a precision frequency standard and is corrected to agree with astronomical observations. These time signals (or time ticks) can be received at a remote point and applied to a time comparator consisting of a similar frequency-standard driven clock equipped with a calibrated delay measuring circuit and oscilloscope indication. Such a system provides a practical means for long-distance comparison of frequency and time over long periods of time. The clocks at the time transmitter and at the receiver, in effect, continuously count the cycles generated by the frequency standards. In other words, the clocks are essentially time integrators: the longer the time period over which they count, the more accurate the results.

One millisecond of time in a 24 hour period represents approximately $1p/10^8$. If it is possible to observe accurately a difference of 0.1 millisecond (100 microseconds) in 24 hours, frequency can be checked to $1p/10^9$ per day. The resolution can be increased by developing the capability of observing smaller time changes accurately or by measurement over a longer period of time—for instance, 10 to 100 days. The average accuracy of frequency determination increases directly as the increase in ability to resolve smaller increments of time difference.

World-Wide Coverage

Time pulses transmitted by high-frequency (HF) radio emissions in the 3 to 30 megacycles per second (MC) band are easily observed up to the limit of HF radio coverage. The doppler shift of the carrier is averaged out or appears as a certain amount of scatter for each measurement. If care is taken to always record the time pulse that shows the least delay in transmission, it is possible to obtain 1/10 millisecond resolution over a path that may be as long as 5000 miles.

HF radio waves are not nearly as dependable a long distance broadcast means as are emissions in the very-low-frequency (VLF) band which extends below 30 KC. On the other hand, as frequency decreases below 100 KC, time pulses are increasingly shaped and delayed by the time constants of the high-Q antenna typical of VLF and LF installations.

If the carrier wave is accurately controlled at the transmitter, phase comparison using the received VLF carrier yields much more accurate results than does time pulse measurement for synchronizing the frequency of widely separated precision oscillators. The phase method also is more rapid. In fifteen minutes, sufficient information can be obtained from transmissions over an all daylight path in the 15 to 25 KC band to correct frequency to $1p/10^9$, and it is possible to compare to $1p/10^{10}$ with 3 hours of phase change information. It is possible by phase change measurement at VLF to observe one microsecond difference whereas pulse starting time cannot be observed accurately closer than 0.1 millisecond (100 microseconds).

One of the methods used to determine microsecond changes in time is based on observation of the progression of zero voltage (crossover) time of the individual cycles of the received VLF carrier as compared to the cycles of a local frequency standard. The sweep circuit of an oscilloscope can be locked to the local standard to observe the changes in phase in terms of microseconds of time.

Special time measuring equipment, such as developed at the Naval Research Laboratory and now being offered for commercial sale by at least one manufacturer, is necessary for determining the time of day accurately. For highly accurate knowledge of time of day, it is necessary to correct the apparent time to include the signal delay introduced by propagation from transmitter to receiver and to use correction data for the particular location as obtained from U. S. Naval Observatory bulletins.

Atomic Frequency Standards

An outstanding precision frequency development of the past few years is based on the application of atomic resonance phenomena induced in certain vapors or gases. A device of this nature is commercially produced in this country; this is the cesium beam type instrument known as the Atomichron. One of these instruments has been used at the Naval Research Laboratory as a reference standard since September 1956. A cesium beam resonator was constructed and placed in operation at the National Physical Laboratory (NPL), Teddington, England, early in 1955, by Dr. L. Essen.

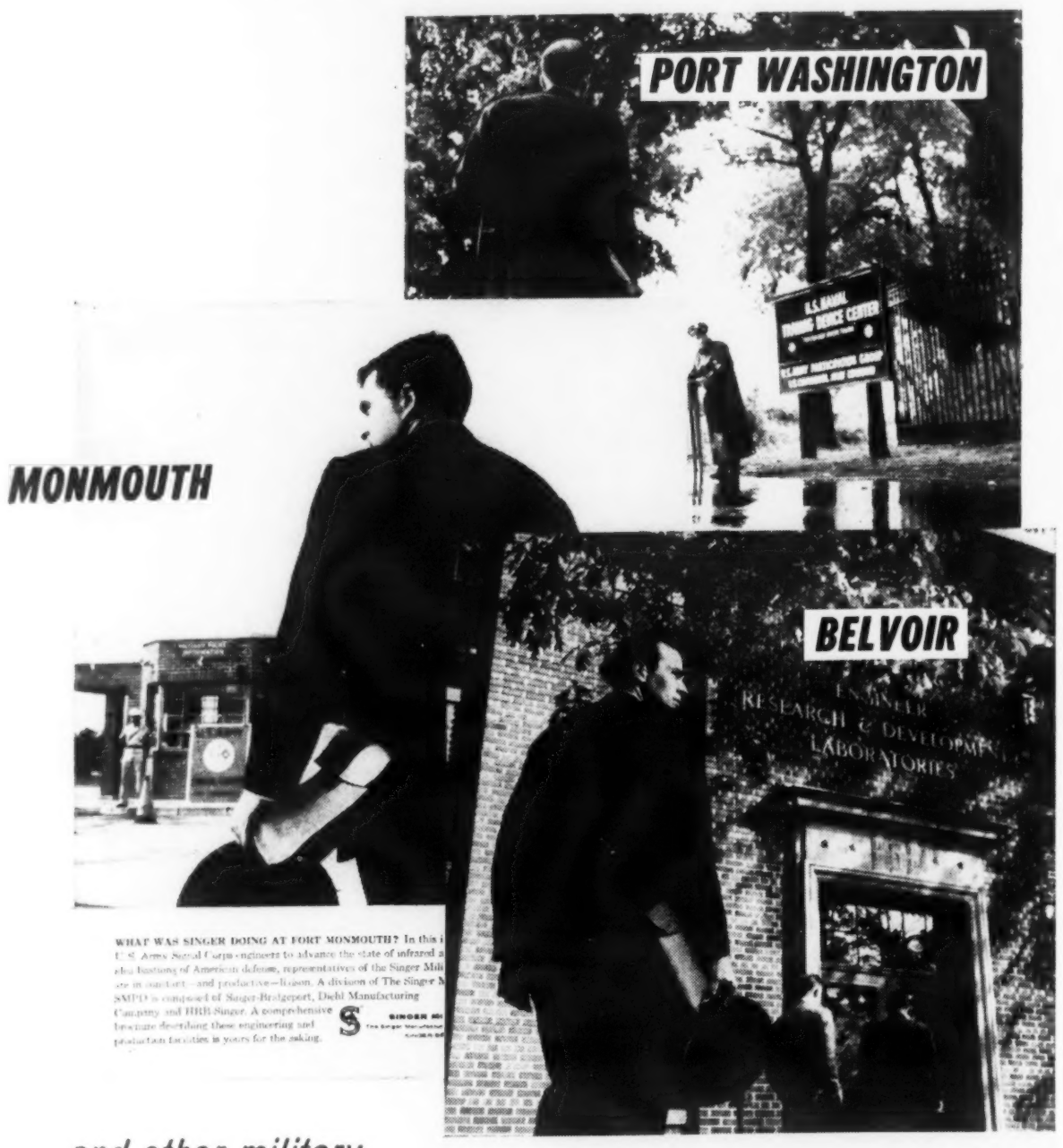
The UT-2 second of time by which we live has small variations as the seasons and years change. Also, it lengthens as the earth's rotation slows down. Therefore, to standardize frequency, it is necessary to reference an invariant oscillation such as that provided by the cesium beam standard to some particular second of time in an essentially invariant time system such as ET, which is defined by the orbital motion of the earth about the sun. The cesium beam standards at the National Physical Laboratory and the Naval Research Laboratory have been used since 1955 and 1956, respectively, in a cooperative program with the U. S. Naval Observatory for the accurate determination of Atomic Time, A-1.

National and International Comparison of Frequency

To aid in the transmission of highly accurate time information over both short and long distances via constant frequency radio carrier modulated by precise time pulses, the Naval Research Laboratory has developed new techniques and provided special instrumentation to the Naval Observatory. NRL relays atomic frequency data to the Naval Observatory. The Observatory is then able to provide time in terms of the number of cycles of the cesium standard that occur in the standard second of time and it is possible to duplicate that second anywhere by reference to a cesium standard.

By comparing the 18 KC time pulse broadcasts of U.S. Navy VLF station NBA (Balboa, Canal Zone) with the 16 KC time pulse broadcasts of station GBR (Rugby, England), it has been possible to compare the cesium standard at the National Physical Laboratory, which is used to control GBR, with the cesium standard at NRL that controls NBA through the Naval Observatory. Similar comparison of British and U.S.A. standards has also been made by HF radio transmissions. Consistent agreement to about $2p/10^{10}$ has been achieved

WHAT IS THE SINGER MAN DOING AT:



and other military installations

WHAT WAS SINGER DOING AT FORT MONMOUTH? In this ... U.S. Army Signal Corps engineers to advance the state of infrared ... also hastening of American defense, representatives of the Singer Mil... are in constant—and productive—liaison. A division of The Singer M... SMPD is composed of Singer-Bridgeport, Diehl Manufacturing Company and HRB-Singer. A comprehensive brochure describing these engineering and production facilities is yours for the asking.

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WHAT WAS SINGER DOING AT FORT BELVOIR? At this important Army Engineer Development Laboratory, tight 24-hour guard must be maintained. Here the SWAMI Motion Detector, developed by the Singer Military Products Division, is now undergoing rigorous tests and evaluation as a security device. No bigger than an attache case, SWAMI is designed to secure a critical area with ultra-sensitive radio energy. A division of The Singer Manufacturing Company, SMPD is composed of Singer Bridgeport, Diehl Manufacturing Company and HRB-Singer.

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in the measurements.

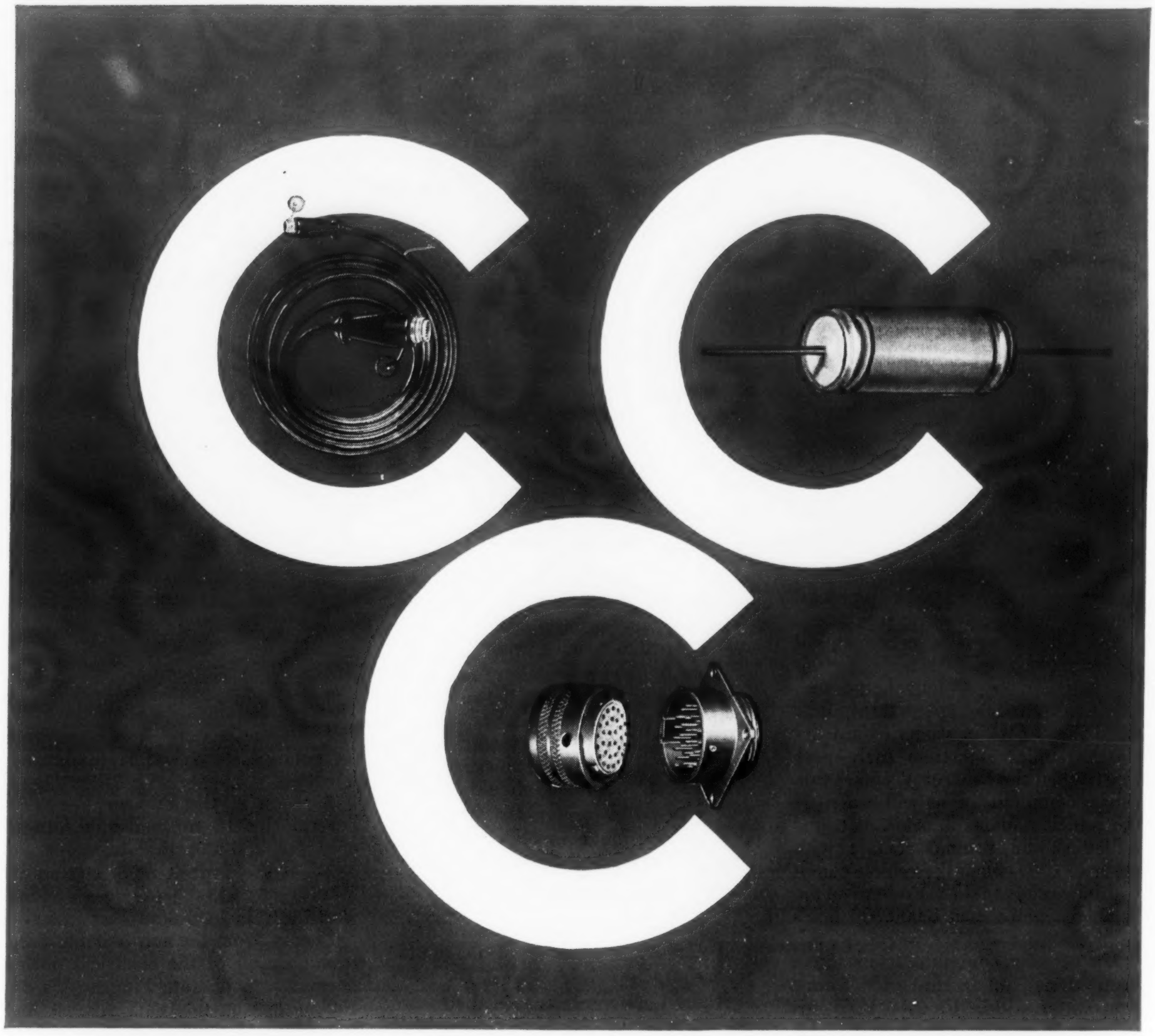
By recent arrangement between the Naval Observatory and Greenwich Observatory, England, cesium standards will be used to maintain the U.S. Navy and British VLF stations on constant frequency and synchronized time. The two Observatories will consult and correct time simultaneously when it becomes necessary to make any change.

Electronic Devices

In its cooperation with the U.S. Naval Observatory, the Naval Research Laboratory has developed various new electronic devices. One of these is a precision time standard for keying transmitters at Annapolis, Md.; Balboa, Canal Zone; San Francisco, California; and Guam. Similar equipment has also been developed for use by the Observatory at Washington, D. C., and Richmond, Florida, to monitor the transmitted time signals and to provide time instructions to the transmitting stations when necessary. These equipments provide a resolution of 0.01 millisecond, with time correction capability up to the instant before time signal transmission starts. One of the interesting features provided in the Observatory equipment is a combination mean and sidereal divider that produces two outputs with a constant ratio of 1.0027379091 from one accurate 100 KC source. Thus, any correction of the source corrects both the mean and sidereal frequency at the same time.

An instrument for accurate comparison of the phase of 2.5 MC and 5 MC carriers has also been provided to the Observatory for monitoring the phase of station WWV (or any other transmissions of similar nature). The measurement is, however, not accurate for distances greater than 20 miles because of the multipath and doppler shift effects that occur in the space between transmitter and receiver in HF radio systems.

NRL has provided the electronic instrumentation and technical assistance needed to convert Navy station NBA to provide the highly precise time and constant frequency broadcasts at 18 KC which started on a scheduled basis on 1 December 1959. As the necessary equipment becomes available and is installed, four other U. S. Navy VLF stations will begin operation to provide coverage of the world with constant frequency carrier in the 15 to 25 KC band. This will be accomplished without impairing the communication capability of the stations, thus providing most economical use of the limited facilities of the VLF spectrum band.



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PIONEER V

SIGNAL STAFF REPORT

COMMUNICATIONS OVER an interplanetary distance of 100,000,000 miles may be achieved for the first time in the history of space exploration if Pioneer V, the United States' aluminum space laboratory, continues in its successful orbital path between earth and Venus.

The key instrument in the space laboratory is its 150-watt transmitter, believed to be the most powerful transmitter ever flown into deep space. Containing solar cells that will recharge the payload's nickel-cadmium batteries every four hours and fifty-five minutes, the transmitter should send back messages from 100,000,000 miles sometime early next year. When the Pioneer V passes this range, communications will cease. If the vehicle remains in orbit, its transmitter should resume contact with earth in 1963, when the vehicle comes within range again. Presently, the vehicle is more than 8,000,000 miles from earth.

Up to now communications have been carried on by use of a 5-watt transmitter within Pioneer V. Until Pioneer V surpasses the 5-watt transmitter's range, which is approximately 10,000 miles, the small unit will continue to send information back to earth by providing fifteen to twenty minute transmissions every five hours. Then the 150-watt unit will be turned on and the 5-watt unit will act as an amplifier for it. It is expected that the large transmitter will be turned on very soon. It will provide five minute transmissions every five hours.

Pioneer V contains a tiny, intricate electronic brain designated "telebit," which collects, stores and tallies data collected by the satellite's fact-finding instrumentation all at the same time. On command from the ground stations, "telebit" relays the scientific data it has collected via the transmitter to earth. "Telebit" is an advance over earlier telemetric systems in satellite or space payloads which had to relay information continuously. This continuous relay of information limited the systems to single, one-at-a-time responses and caused continuous heavy drainage of the batteries on which the transmitters depended.

Launched from Cape Canaveral, Florida, by the National Aeronautics and Space Administration, March 11, Pioneer V is conducting experiments in radio propagation, magnetic fields and radiation. The 94-pound vehicle will provide previously unknown data about the fundamental nature of the solar system and space itself.

Units of the space laboratory will map the magnetic fields between the earth and the orbit of Venus. Since the magnetic fields of space influence weather and radio transmission, the information obtained should prove valuable.

Collecting data on the magnetic field perpendicular to the spin axis of Pioneer V is a half-pound search-coil magnetometer. The three tiny packages of the search-coil can detect and classify a number of magnetic field characteristics.

Radiation experiments in the space laboratory will give a picture of the intensity and extent of the radiation belts first discovered by the Explorer satellites. Pioneer V will send back data on radiation more distant than any previously examined.

A unit called a proportional counter "telescope" will measure cosmic rays. Capable of distinguishing very high energy radiation in the presence of induced secondary particles, the unit will explore the high-energy radiation trapped in the earth's magnetic field. The unit also will monitor varying-energy solar rays.

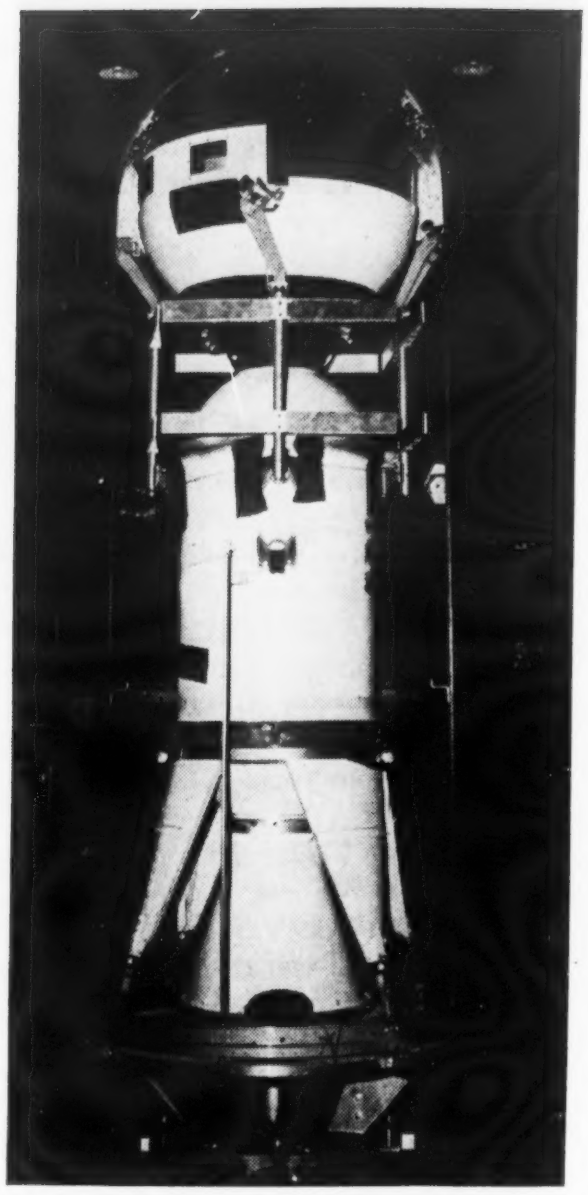
To receive the telemetered information on the space laboratory's experiments, a world-wide network of tracking and radio receiving stations was set up with five primary stations located at Cape Canaveral, Florida; Singapore, Malaya; Manchester, England; Kalae Field, Hawaii and Millstone Hill, Massachusetts. These stations are part of the Space Navigation Network, SpaN Net, which was established in 1958 to meet the needs of the Air Force Project Able space probes. These stations also send commands to the Pioneer V for specific operations within the vehicle.

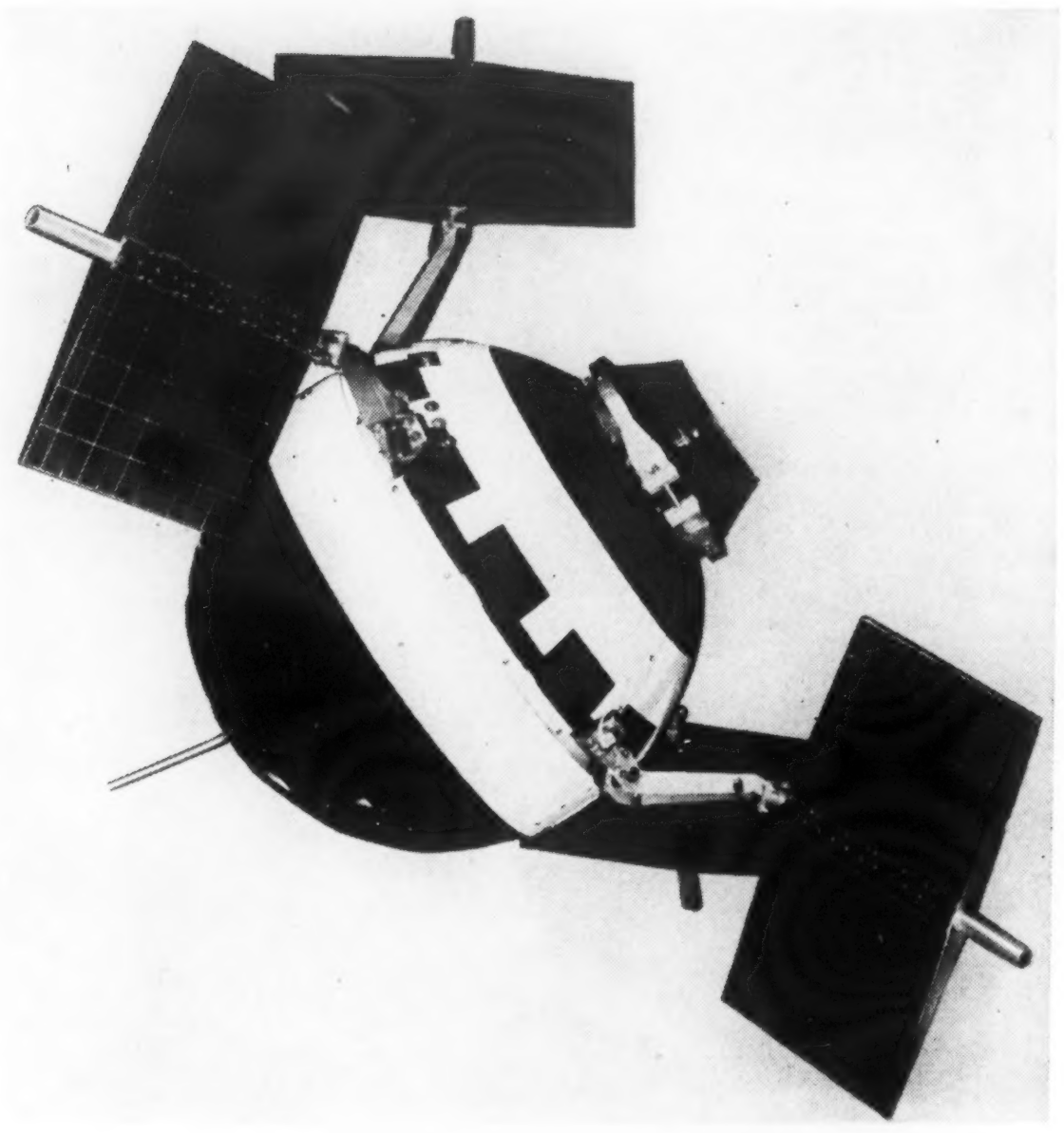
Through these stations the satellite's radioed messages are received and teletyped directly to the SpaN Net's nerve center in Los Angeles. Here the coded information gathered by "telebit" and sent back to earth by the transmitter is demodulated and punched into teletype tape. The teletype data tapes are fed into a central digital computer which processes the tapes and then prints out the solar system data in chart or graph form for detailed study and evaluation by scientists.

As soon as the Pioneer V passes beyond the 10 million mile range, only the 250-foot radiotelescope located at the Jodrell Bank station in Manchester will be in close contact with the vehicle.

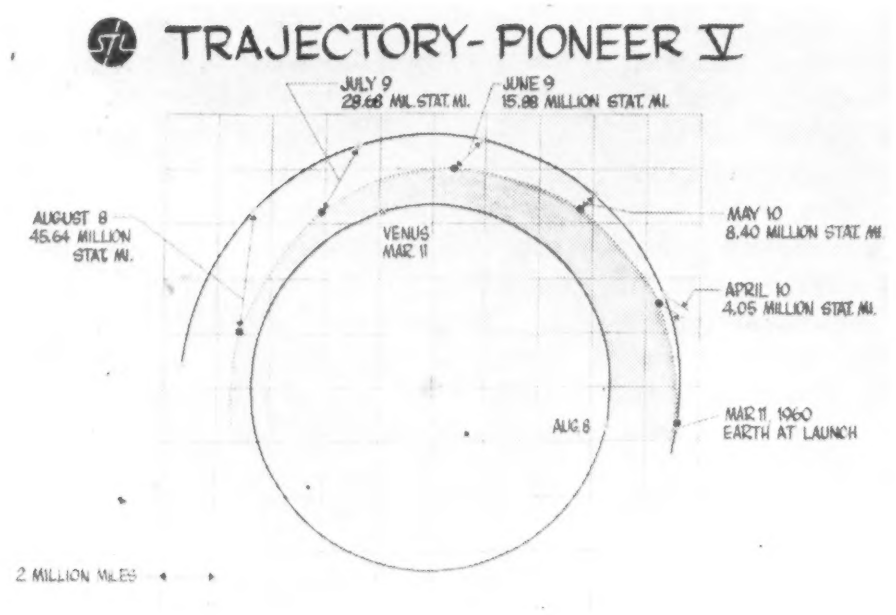
Energy from the sun is being used to supply all of the electrical power necessary to operate Pioneer V's array of instrumentation. Almost five thousand solar cells mounted on four paddles extended from the satellite's shell harness about eight percent of the sun's energy impinging at each cell. The solar cells then convert this energy to electricity. To insure a constant supply of power the electricity is stored in batteries located within the payload for use when necessary. The complete power system weighs 25 pounds and has a minimum lifetime of one year.

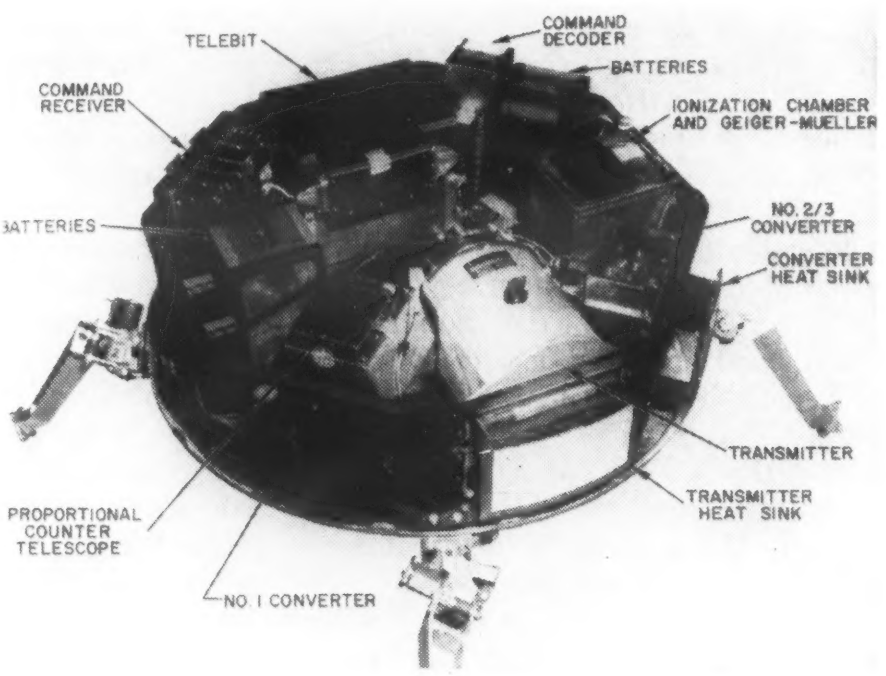
Space Technology Laboratories, Inc., is the systems manager for the Pioneer V space probe. Members of the STL staff provided the over-all systems engineering and technical direction for both vehicle and payload. They were responsible for the operation of the world-wide tracking and communication network and the research and development of components and subsystems used for both launch control and tracking equipment.





(Upper left) Atop the third stage of its rocket booster and hooded by half of the fiberglass shroud, the shell of *Pioneer V* awaits final check-out by technicians. Before the planetoid was hoisted to the nose of its modified Thor booster, the solar-cell paddles that supply the payload's electrical power were attached and the payload was ready for flight. Some experiments peer out through the rectangular windows visible in the planetoid. (Upper right) The 90-pound highly instrumented space planetoid, *Pioneer V*, poised as it will be during its flight to the orbital path of Venus. The four solar-cell paddles convert solar energy to electricity. The special paint patterns and heat sinks will reflect or absorb heat and radiation to adjust temperatures of the paddles and interior to the most efficient operating level. The small white plates above the planetoid's equator are the sensing elements for experiments aboard, which include devices to measure radiation, magnetic fields, micrometeorite density, radio propagation effects, and other space phenomena.





Gen. Cook, at his home Ham station, is one of a few general officers on active duty whose hobby is operation of amateur radio equipment.

HISTORICALLY SPEAKING!

MAJOR GENERAL EARLE F. COOK
DEPUTY CHIEF SIGNAL OFFICER

On JUNE 21 of this year we mark a Century of U. S. Army Signals.

We all know that the methods and techniques of communication have undergone profound changes in that hundred years since the adoption of Major Albert J. Myer's comparatively simple wig-wag system for the Army.

Then, we were concerned with getting the message across a valley or from one signal tower to another, or later, in getting a spark gap to "gap." Now, we speak in terms of bouncing signals off the moon, of voice and teletypewriter signal by radio relay from outer space, of securing meteorological data from the infinity of space and using space itself from which to collect meteorological data by satellite, such as VANGUARD II and TIROS. We speak in terms of global communications so swift and so efficient that one cannot help but contemplate these accomplishments with respect and with pride at being in the communications business. The invention and development of radio to its current potential makes these remarkable achievements possible.

Apart from our common bond of interest in radio, our esteem for the amateur ("Ham") is also that which one holds for a prime national reserve asset. Amateur radio operators are an invaluable and indispensable American source of operational and technical skills in time of war or other emergency need. Under various sponsors they also provide auxiliary systems or means of communication which can be made available to military commanders as required.

One of the most important values inherent in the amateur service today is an ever-increasing willingness of its members to devote themselves and their equipment to civil or military emergency type communication services. This is shown by the number of amateurs engaged in these activities and by such programs as the Amateur Radio Emergency Corps or AREC, sponsored by the American Radio Relay League, and the Radio Amateur Civil Emergency Service or RACES, which is sponsored by the Office of Civil and Defense Mobilization. In the same category are the many hundreds of naval reservists who are radio amateurs and maintain their own personal equipment at their homes. Through these sets they actively engage in the Naval Reserve Operational Communications Network for training and volunteer military and civil emergency service.

More closely associated with the U. S. Army Signal Corps is MARS—the Military Affiliate Radio System. The MARS program is jointly conducted by the Army and the Air Force as a training and auxiliary communications facility. The foundation of the MARS system is the approximately 13,000 licensed radio amateurs throughout the nation and at certain overseas locations. Today's MARS program contrasts greatly with the early beginnings of joint military and amateur activities.

It was early in 1925, at Camp Alfred Vail, now Fort Monmouth, New Jersey, that affiliation between the Army Signal Corps and the radio amateur was first discussed. Major George L. Van Deusen, now Major General retired, then the Commandant of the Signal Corps School, directed Captain Tom Rives of the School to prepare a study on the subject. The study by Captain Rives, now Brigadier General, USAF, retired, recommended the establishment of an Army Amateur Radio System.

The system was approved by the Chief Signal Officer and in August of 1925 Capt. Rives met with the late Hiram Percy Maxim, Jr., then President of the American Radio Relay League, and Ed Handy, a former Colonel in the Signal Corps. In October 1925 *QST* magazine published the agreement between the Army Chief Signal Officer and the ARRL in establishing the new Army Amateur Radio System or AARS.

The AARS was redesignated as the Military Amateur Radio System in 1948 and was renamed the Military Affiliate Radio System, or MARS, in 1952.

The present day MARS program provides an existing potential of trained personnel in military type communications. They have learned military procedures and traffic handling. They have a capability to handle traffic in emergencies and can extend regular military communications systems when required.

Volunteer amateurs operating

MARS stations have participated in numerous Army communications exercises. The success of these proved that MARS must be considered as one of the country's important communications assets.

The radio amateur performs many selfless services for his own community, his state, and his country and its military services, that go far beyond simple self-enjoyment of a hobby. He is a dedicated man with a strong creed of helpfulness and assistance to others —a communications "Minuteman"— who stands ready to lend a competent hand in times of local disaster, national emergency or war.

On a lighter note, it has often seemed odd to me that we should still use the term "amateur" for those so thoroughly professional in ability. I realize it has to do with the accepted distinction between those in business to make money and those simply following a hobby for enjoyment. Yet I might say here I have known a couple in the former category who often swear they must be following the latter.

In any event, radio amateurs are coupled with success—whether it is making a new beam load the first time or getting a Christmas message back from some remote spot to the sender's family.

We are glad when opportunities arise in which we can return such loyalty and support to amateur radio. One such area is in the maintenance of the frequency allocations for the amateur service. Without appropriate allocations, there could be no amateur radio.

We are all aware that whenever a change in frequency allocations is considered, the amateur bands invariably get a "hungry look" from those desiring to expand. Much like an untuned transmitter, these factions have a tendency to spread. The military services have always vigorously opposed any proposals to cut down on the size of the amateur bands.

All of you recognize the significance of the World Conference of Governments in Geneva, Switzerland, which ended last December, as it affects a new international radio treaty. The treaty which resulted provided for continuation of the size of the frequency allocations for amateurs —*without reduction*. What many may not know are the difficulties which arose and the real victory that keeps the "status quo" represented. You might be interested in hearing something of the behind-the-scenes effort that made this agreement possible.

As you know, the frequency bands which amateurs have been using for a number of years are derived from an international radio treaty negotiated in Atlantic City in 1947. This treaty came up at Geneva for review and possible revisions. The allocations for all uses of radio were under scrutiny.

During the three years of preparatory work for the Geneva Conference, military representatives on State Department committees adhered to the position that there should be no change in the allocation to amateurs. Consequently, the official position of the United States at the Geneva Conference last year was to staunchly defend and preserve the amateur bands.

At the beginning of the Conference, it appeared that delegations of many countries were anxious to reduce the size of the principal long-distance amateur frequency bands. Inroads on these bands have been made at previous conferences of the International Telecommunications Union. Every U. S. amateur can be proud and gratified that the United States delegation to this Conference took a very strong stand and insisted on maintaining the present status on all of the long distance amateur bands below 30 Mc.

The 80-meter band was in jeopardy early in the Conference because of proposals of countries within our own hemisphere. After informal discussions between our delegation and the other delegations concerned, this crisis was smoothed over and no changes whatsoever were made to the Atlantic City allocations.

"Forty meters" was in the most serious trouble in its history. Several groups of countries, with some encouragement from some delegations from the Americas, wanted to introduce short-wave broadcasting between 7100 and 7300 kc. This is, of course, the existing allocation outside the American Hemisphere, with some sharing in some countries by amateurs between these frequencies. The United States delegation organized a series of consultations with the other delegations involved. When the decisive moment came at the Conference, we succeeded in obtaining votes to maintain the entire 40 meter band. The frequencies between 7000-7300 kc would remain exclusively for amateurs throughout the American Hemisphere. Moreover, 7000-7100 kc is maintained world-wide exclusively for amateurs. Outside the Americas the band 7100-7300 kc is exclusively for broadcasting, except in South Africa where it will still be available to amateurs.

The Conference set a precedent in adopting a Resolution which calls for the discontinuance of the outlaw broadcasting stations now operating between 7000-71000 kc. Some of the countries engaged in this type of operation took formal reservations and indicated they would not remove their broadcast stations from this band. The same Resolution which focuses on these broadcasters also looks toward the confinement of interregional contacts in the 40-meter band between 7000-7100 kc. This restriction cannot of course be implemented until the broadcasting service vacates the band 7000-7100 kc. The hard achievement is that the entire 300 kilocycles are maintained for amateurs throughout the whole American Hemisphere.

The 20-meter band was seriously endangered at the Geneva Conference. Certain countries proposed drastic reduction in its size in order to expand the allocations for short-wave broadcasting. The U. S. Delegation's firm position prevented any change in the Atlantic City allocations.

Attempts were also made to slice a very few kilocycles off the low frequency end of the 15-meter band to accommodate certain of the space research projects now being planned. The United States Delegation insisted that the proposed transmissions from space vehicles could be made on a non-interference basis without mention in the treaty just as the Russian Sputniks now use the 20 Mc standard frequency band. We were successful and the treaty makes no change of any kind in the Atlantic City allocations for the 21 Mc or 15-meter band.

A number of countries proposed reductions in the 10-meter or 28 Mc band. Most of the proposals were to reduce the size of this band by 700 kc so that the amateur band would only be one megacycle wide between 28 and 29 Mc. The United States Delegation was not able to find the answer to this problem until almost the end of the Conference when finally the sponsoring delegation withdrew its proposal. In response to an appeal of the United States Delegation, all of the other countries involved followed suit.

The outcome of the Geneva Conference, as far as amateurs are concerned, is far better than any of our frequency experts had dared to hope. I am proud to say that the United States spokesman on the United States Delegation responsible for this outcome was the Army Frequency Manager, Mr. Albert L. McIntosh, a senior Signal Corps employee.

Henry Lehne, a Senior Vice President of Sylvania and General Manager of Sylvania Electronic Systems (left) and Eugene J. Vigneron, General Manager of the Division's Data Systems Operations in Needham, Mass., inspect console of MOBIDIC computer prior to its departure for Fort Monmouth for evaluation testing at the U. S. Army Signal Research & Development Laboratory.

SYLVANIA ELECTRONIC SYSTEMS, *five years of explosive growth within the defense systems industry*

by ROBERT E. LEWIS, PRESIDENT, SYLVANIA ELECTRIC PRODUCTS INC.

(A subsidiary of General Telephone and Electronics Corp.)

SEVERAL MONTHS AGO, Donald C. Power, Chairman of General Telephone & Electronics Corporation, announced that over-all responsibility for GT&E government systems management has been centralized within Sylvania Electronic Systems, a major division of our company. The responsibility embraces proposals to the government for major defense systems programs, and the management and technical direction of contracts resulting from such proposals.

To Sylvania's management, this centralization represents a climax to five explosive years that followed one of the most important decisions in the 59-year history of the company: to get into the defense systems end of the electronics business with both feet. I say "explosive years" advisedly, since the formation of Sylvania Electronic Systems was like firing a missile, then standing by to watch its ascent. Little more than five years ago, the division didn't exist. Today, its 7700 employees (including 1800 engineers) are conducting advanced research and development studies, and manufacturing electronic components, sub-systems and systems for all of the armed services in 10 laboratories and six plants throughout the country. More than 1,000,000 square feet of floor space are devoted to these activities.

Wide Range of Capabilities

Today, the capabilities of Sylvania Electronic Systems cover a complete spectrum, encompassing detection, tracking and defensive missile systems; electronic warfare systems, data processing systems; communication, navigation and intelligence systems; support systems, and related military electronic equipments, components and study programs. Throughout the world, its field engineers are working side by side with military personnel—on data processing systems in Germany, communications systems in Japan, and missile warning systems in the Arctic. Significant projects of the division include:

—Development and production, under a contract with the Army Signal Corps, of the MOBIDIC computer system for the field armies.

—Management of the Electronic Defense Laboratories, a quick-reaction facility established by the Army Signal Corps for rapid development of electronic countermeasures against enemy weapons.

—Development of the AN/MPQ-32 weapons-locating radar equipment, under contract with the Army Signal Corps.

—Development and production of the "electronic shield" or automatic defense system for the Air Force's B-58 "Hustler" supersonic bomber.

—Development of and production for the data processing phase of the Air Force Ballistic Missile Early Warning System (BMEWS).

—Development of communications systems for the Navy's Polaris program.

—Development and production, under a Navy-Air Force contract, of the first digital flight trainer, called Universal Digital Operational Flight Trainer (UDOFT).

With ever-expanding capabilities in advanced electronics, the potential for equally remarkable expansion over the next five years is very much with us. As government systems manager for GT&E, a corporation with assets of nearly $2 billion, Sylvania Electronic Systems coordinates the broad defense systems capabilities of the corporation's various subsidiaries—Automatic Electric Co., Leich Electric Co., Lenkurt Electric Co., Electronic Secretary Industries, Inc., General Telephone & Electronics Laboratories Incorporated, and 30 domestic telephone operating companies with extensive skills in the areas of installation, operation and maintenance of communications systems.

Automatic Electric produces dial telephones and other switching equipment, communications systems, and electric control equipment. Its ship's service telephone systems have long been used by the Navy. Lenkurt is a manufacturer of carrier current and microwave radio equipment. Leich makes telephones and central office equipment, while Electronic Secretary produces automatic telephone answering equipment and automatic electronic warning devices.

GT&E's Integrated Systems Capabilities

To underscore the full significance of GT&E's broad defense systems capabilities, it is noteworthy that GT&E is one of the few, if not the only, single source of an integrated systems capability combining telecommunications, data processing and electronic display. We recently announced plans to expand production within our Sylvania Electronic Tubes division of electroluminescent display devices for a wide variety of military and civilian applications including computers, radar and information displays. Sylvania pioneered the development of electroluminescence, and in 1950 was the first company to manufacture lamps utilizing the principle.

GT&E's domestic operations include more than 50 manufacturing plants and 24 laboratories in 44 communities in 15 states, in addition to the 30 telephone operating companies which serve portions of 31 states. Now that responsibility for government systems management for this diversified industrial organization has been assigned to Sylvania Electronic Systems, the remarkable story of the division's origin and growth—under the direction of an engineering and management team led by Henry Lehne, a Senior Vice President of Sylvania and General Manager of the division—takes on added drama.

Our company's present team efforts with the armed services, of course, can be traced back to World War II—when our then new subminiature tube was the heart of the proximity fuse, one of the most decisive weapons of that conflict. Today, some 58 tube types in Sylvania's subminiature line are used in all types of airborne radar and radio communications equipment where small size, light-weight and superior resistance to shock and vibration are required. In the F-106 jet fighter, for example, our subminiature tubes operate in computers which control the automatic firing equipment of the airplane.

Some of GT&E's Significant Defense Programs

Other significant defense programs include delivery of more than 50,000 AN/ARC-3 receiver transmitter systems to all of the armed forces during World War II and the Korean War; production of the SPS-10 search radar set, which is now operating in fleet service in more than 300 vessels ranging from destroyers to aircraft carriers; military installations of an Electronic Flash Approach System (EFAS) for early airport runway identification, and a variety of other electronic components and equipments.

The nucleus of what eventually became Sylvania Electronic Systems grew out of several diverse activities of the company that were underway by 1953. These activities were:

1. The Government Operations Section of Sylvania Home Electronics, another division of the company, which was formed in Buffalo, N. Y., to consolidate activity on communications, navigation and related equipment being manufactured for the armed forces.
2. The Boston Engineering Laboratory, where the automatic electronic defense system for the Air Force's B-58 "Hustler" bomber was under development.
3. The Missile Systems Laboratory in Whitestone, Long Island, N. Y., which was developing the PLATO anti-missile missile system under the technical supervision of Redstone Arsenal, Huntsville, Ala., and the contract supervision of the New York Ordnance District.
4. The Electronic Defense Laboratory (EDL), Mountain View, Calif., a quick-reaction facility established by the Signal Corps for rapid development of electronic countermeasures against enemy weapons.

EDL represented a pioneering effort by the Army Signal Corps to create a quick-reaction facility operated by a military-industrial team. Recognition of a need for such a facility that could cut the all-important lead time in the arms race with the Communist world evolved out of the Korean hostilities. The quick-reaction concept itself, incidentally, was patterned after the World War II activity at Harvard University's Radio Research Laboratory.

Mr. Lehne, formerly Vice President in charge of sales of Republic Aviation Corp., joined Sylvania in January, 1953, as director of the newly formed EDL—working with a handful of engineers at the rear of Sylvania's Microwave Tube Laboratory in Mountain View. The following year, a 65,000-square-foot EDL facility was completed and engineering strength expanded proportionately.

Late in 1954, Sylvania Electronic Systems was established, with Mr. Lehne as General Manager of the division with headquarters in Buffalo, N. Y. The Boston Engineering Laboratory, the manufacturing plant in Buffalo, where production was underway on the B-58 electronic defense system, and the Electronic Defense Laboratory were incorporated into the new division, the company's ninth operating division.

In September, 1955, a new 120,000-square-foot building was dedicated on a 10-acre site overlooking Route 128 in Waltham, Mass. Called the Waltham Laboratories, it provided facilities for the division's new Avionics Laboratory, formerly the Boston Engineering Laboratory, and the Missile Systems Laboratory, which had been moved to Waltham from Long Island.

Division Headquarters Established in Waltham

To benefit from the widely recognized electronics climate of the Greater Boston area, Mr. Lehne transferred the headquarters of Sylvania Electronic Systems to Waltham early in 1956—completing formation of the foundation upon which later division expansion was built. This expansion has continued unabated, and we are confident it will extend well into the future as Sylvania works in partnership with all of the armed forces to provide insurance against aggression.

ITT KELLOGG*

Military Communications Systems

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MANAGEMENT RESPONSIBILITIES TOWARD RELIABILITY

by R. J. NORDLUND
Technical Director
Weapons Guidance Laboratory
Wright Air Development Division

THIS PAPER IS intended as a study of the basic nature of the reliability problem concerning the "building blocks" for missiles and space vehicles. The intent is to approach the problem of basic goal definition from the standpoint of our broad national interests and to examine the roadblocks in the way of achieving the goal. Although the problems are equally serious and difficult in the mechanical and the electro-mechanical areas, this discussion is intended primarily for the various managements which comprise the electronics industry of our nation.

It has been a matter of great concern to the author since the end of World War II that the quality of the component parts which must form the heart of ever increasingly complex electronic instrumentation is completely inadequate even for present-day requirements. It is encouraging that some leaders in the industry are now becoming aware of the gravity of the situation as evidenced by statements published in the March 1959 components issue of SIGNAL.[1]

The designer of complex systems today is in much the same situation as an architect would find himself if he were commissioned to design a skyscraper to outdo the Empire State Building, and then discovered that his best building material was adobe blocks.

Why is the vital role of basic parts not evident to us? As Paul Darnell, Director, Military Component Development, Bell Telephone Laboratories, Inc., said in SIGNAL,[2] "It should be self-evident." Is it because a resistor, tube, capacitor, valve, relay or tubing joint is not a glamorous thing to a designer? This should not be true in the case of creative designers who can visualize the completed device. I am reminded of two bricklayers I encountered one spring evening in Philadelphia as I was taking my customary evening walk. These men were working overtime on a large new church. The first workman was doing a sloppy job, spilling mortar over himself and the ground. Just for fun I asked him what he was doing and he grunted, "Laying bricks, stupid." Thus suitably rebuffed I walked on a quarter of a block where the second man was working, and was impressed by the contrast. This lad, a tall, lanky, happy-looking colored lad, was doing an extremely neat job. I repeated my question, and this boy straightened up from his work, looked up into the sky and said, "Suh, I'se building a beautiful cathedral." You will find that the truly creative designer must be similarly concerned with the "bricks" that go into the complicated design. In the case of electronics, these "bricks" are, of course, the bits and pieces which must make up the final completed device.

Or is it that we, as scientists and engineers, have become enamoured of the mere achieving of performance, and feel that we have achieved the final goal if we prove the feasibility of an idea and have made something that works, even if it is yet far from satisfactory for the required application?

Or have we as a nation been so busy becoming prosperous during the past 14 years that we have accepted lack of progress in our basic building block quality as a normal thing?

I do know one thing to be true, and that is that we have written and spoken enough millions of words in the past ten years on the unreliability of component parts. It is high time we sit down and define what our goal must be, and then go about the job of achieving that goal. I have no quarrel with most of what I have heard or read, but I feel that our thinking has become stereotyped, and sterile, and we either do not mean what we say, or have failed to put our convictions into action. This paper was conceived one sleepless night on an airplane, when I tried to put myself to sleep by reading the previously mentioned issue of SIGNAL. This particularly well done issue was dedicated to components and I read it from cover to cover. I shall hereafter refer to this magazine as "the book." In his article in that "book," Dr. Homer J. Stewart[3] said, in speaking of the National Aeronautics and Space Administration program, "The guidance and communication equipment must be tailored to suit the special needs of space missions." What did he mean by this, especially the "special needs" part? Let us examine a specific example of such "special need." Preliminary studies indicate that a satellite electronic system, to be economical and generally suitable, should have a 95% certainty of three years' mean-time-between-failure. If the system contains 10,000 component parts—and I know it will if we build it with present techniques—such parts must have a failure rate for each part of approximately 2×10^{-10} or 0.0002 failure per million hours. This is a mean-time-between-failure for each part of about 508,000,000 hours, and this is 58,000 years. Fantastic, isn't it? Impossible too, we might say, and sit down and examine why we want to do such a thing, after all. Obviously, many people are in the frame of mind to thus sit down on the problem, judging from the extreme difficulty of applying resources to the basic problem during the past few years.

I am sure that you will all agree that space has suddenly become our

(*Continued on page* 68)

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New SAC Control System

by ALBERT E. COOKSON
Vice President of Operations and Director
for International Electric Corp. of ITT

TIME IS THE MOST CRITICAL ingredient of the nuclear air age. The Strategic Air Command's reaction time to constantly shifting situations must be as short as modern technology will permit. Complete, instantaneous and positive control of the Strategic Air Command by its commander is a vital requirement if the commander is to employ his forces to the best advantage.

SAC proposed to meet this requirement by recommending the installation of an automatic command control system designated 465L.

When completed, the SAC Control System will display data about thousands of bombers and ICBM's at hundreds of bases on a large viewing screen before the SAC commander and his staff. It will also dispatch the commander's orders, queries and replies to commands and units within seconds. Computers used in the system will process war plans and games by checking compliance of actual events against those planned. Damage reports will be processed automatically and at the same time new target priorities calculated with the necessary data for re-strike planning.

The International Telephone and Telegraph Corporation has been awarded the prime contract to accomplish automation of SAC Control System. The system, now being developed by an ITT asociate, International Electric Corporation, Paramus, New Jersey, consists of three major subsystems: Data Transmission (Remote Communications Complex-RCC and Traffic Control Center-TCC), Data Processing Central-DPC and Data Presentation.

Input data originating at each aircraft base and missile site is introduced into the system via the Remote Communications Complexes, then sent by digital data links to the Traffic Control Centers for automatic switching and routing to processing equipment for updating of files and displays. Through request panels the SAC command staff can call up a variety of information that is stored for rapid access in the system. This capability is in addition to the more routine data that is constantly being displayed and updated.

Remote Communications Complex

The purpose of the RCC (Remote Communications Complex) is to transmit, route and receive all messages to and from centrally located message and data processing centers. Messages originate at the Wing level and enter the 465L System via the RCC for transmission to higher headquarters or other SAC bases. These messages pertain to logistics, intelligence, maintenance, aircraft status, weather, personnel availability and missile readiness.

This information will provide a basis upon which SAC Headquarters in Omaha, Nebraska, can control and direct the SAC force. Conversely, messages originating from headquarters and other SAC bases in the form of orders, alarms, summary data and replies to inquiries, will be transmitted to the RCC for directing the implementation of SAC operations. Messages may also be introduced automatically and directly from other SAC systems.

Data may originate at many sources including diverse locations around the base where an RCC is situated. Information from different base sources, airborne aircraft, or space satellites will be telephoned or radioed to the local command post. There the data will be put into appropriate message format and introduced into the 465L system by means of input devices. Two of these devices will be manually operated keyboards, the other, a semi-automatic message composer. Messages to be entered into the keyboard usually will be narrative in nature and will be given to the keyboard operator in written form. Shorter, standard messages to be entered into the message composer will be received by the operator via telephone or radio.

Traffic Control Center

The Traffic Control Center (TCC) is a communications center into which flow messages and out of which messages emanate.

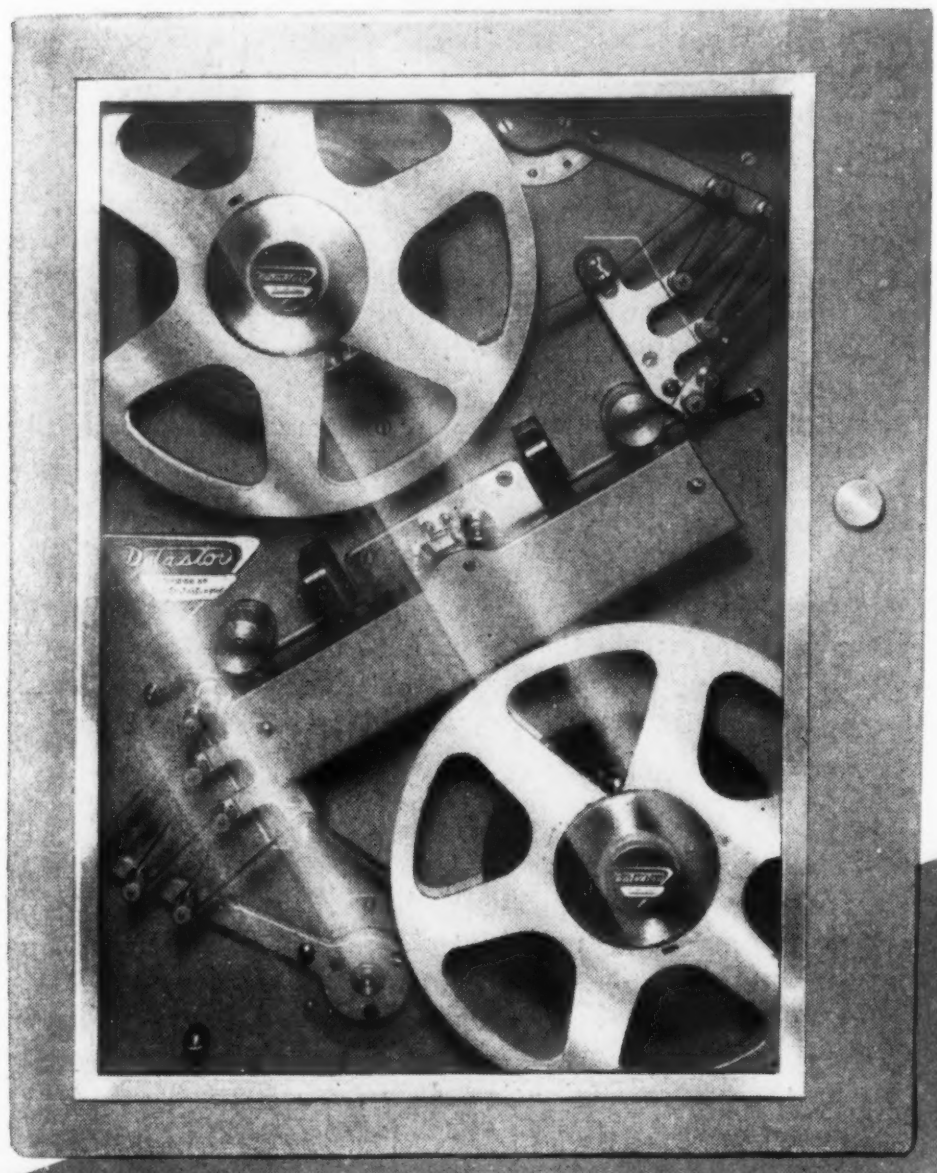
When a message has been completely received by the TCC, it is then processed. This processing consists of making validity checks, transferring the message to temporary and permanent magnetic stores, and determining the necessary routing.

The heart of the TCC is the Stored Program Element (SPE). The SPE will service information requests from the Data Presentation Subsystem in a pre-determined order of priority. These requests are serviced by the SPE to ascertain the location of desired information. If the requested information is located on a magnetic drum, it is read into the SPE core storage from the drum and then directed to the appropriate requesting panel.

If the information is not available on the drum, the request is transmitted to the Military Computer (MC). The computer processes the request, extracts the answer from stored information, and then transfers the information to an output register to be read into the Data Presentation Subsystem. An automatic channel provides two-way communication between the Stored Program Element and the peripheral devices. The peripheral devices in-

(*Continued on page* 53)

Complex and vital information will move through this test console as part of a new nerve system being created now in prototype for the Strategic Air Command of the U. S. Air Force. It will control tests of many computer functions as well as operations of a data-processing sub-system.



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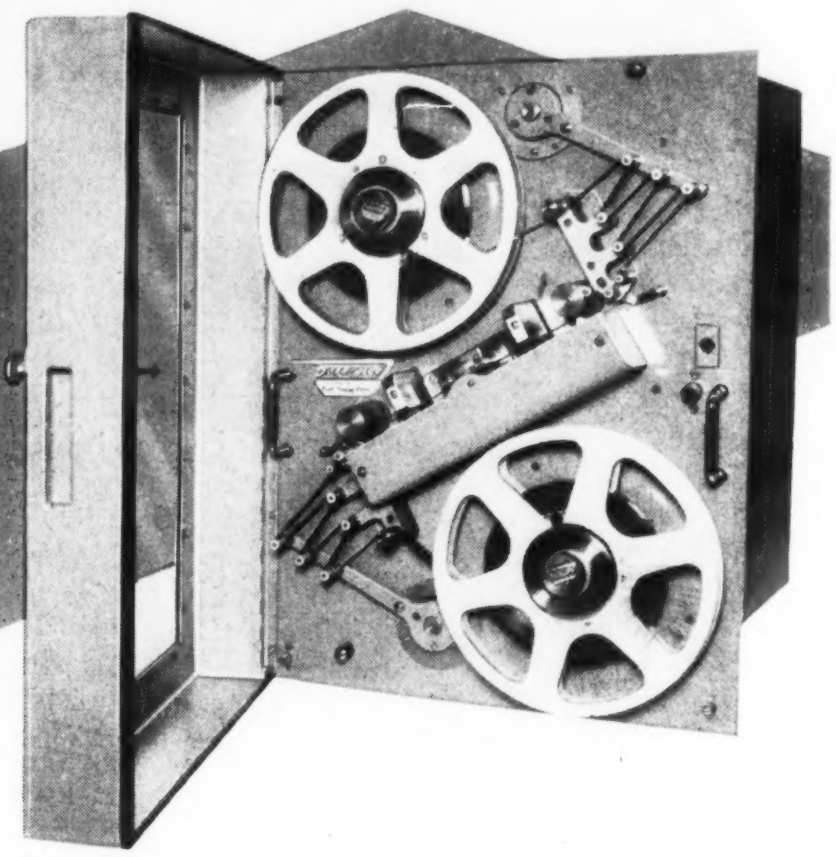

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clude up to 16 magnetic tapes, a high speed printer, a punched card reader and a card punch.

Another important segment of the TCC is the Fault and Facility Control. The Fault and Facility Control primarily monitors the over-all 465L System operation and provides facilities for patching out inoperative equipments. A display panel provides a visual presentation of the status of the major components of the 465L System.

A local Communication Console (LCC) serves the same functions as an RCC except the LCC is located at a headquarters site and provides the means for the SAC commander and his staff to enter data in and receive data from the 465L System.

Data Processing Central

The Data Processing Central (DPC), or Military Computer, is that portion of SACCS which provides data computation, processing and storage of files and/or inventories of the SAC Force. DPC accomplishes these functions at high speed for distribution of status and decision data to other elements of the system.

A central processor unit, peripheral control unit and interrupt and off line processors comprise the DPC.

Included in the central processor are the arithmetic, instruction control and high speed core memory elements. Arithmetic elements perform the usual arithmetic, logical and shifting operations.

Instruction and control elements include the various decoders, counters and indexable registers for rapid program execution. The high speed core memory consists of magnetic banks of 16.000 word capacity. The memory element initially shall have 4 memory banks and can be expanded to include up to eight memory banks.

The Peripheral Control Unit (PCU) regulates the input-output binary traffic of the auxiliary drum, tape memories, TCC/MC communication, typewriter, printer and punch under program and machine control.

The Interrupt System will operate on machine-detected errors. The program will have the option to correct errors by machine or automatic recovery. Or the program can ignore the errors.

Data Presentation Subsystem

The extreme versatility of the Data Presentation Subsystem makes possible the presentation of color as well as black and white displays. Displays include alphanumeric, graphic and geographic information.

The basic Data Presentation System will consist of projection units for furnishing large displays, individual hard-copy printer units for answering individual requests for information, and request panels themselves, which permit individuals to interrogate the system.

Large presentations of data are automatically supplied by projection units called quadrajectors. These quadrajector units can be used in either a front projection or a rear projection mode. All large display panels can be changed in a matter of seconds. All printer units operate simultaneously.

Simulated in International Electric Corporation's test facility at Paramus, N. J., will be the prototypes of various systems to be used in the operational system. The IEC test facility provides a means to test the design and feasibility of the SAC Control System prior to initial procurement of operational hardware. By this means of testing before building, IEC will be able to provide an operational control system that will give SAC a greatly improved capability resulting in decisions based on more reliable data, furnished in a more refined form.

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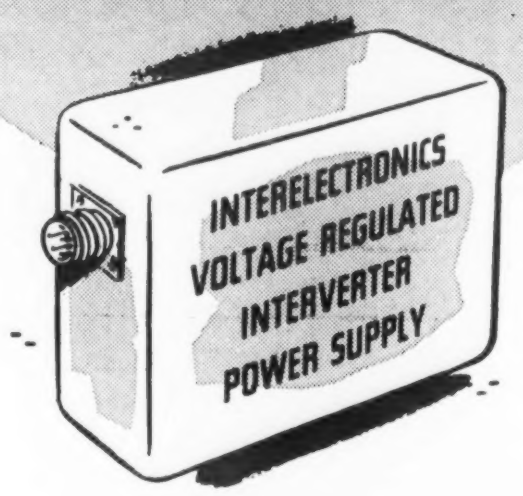

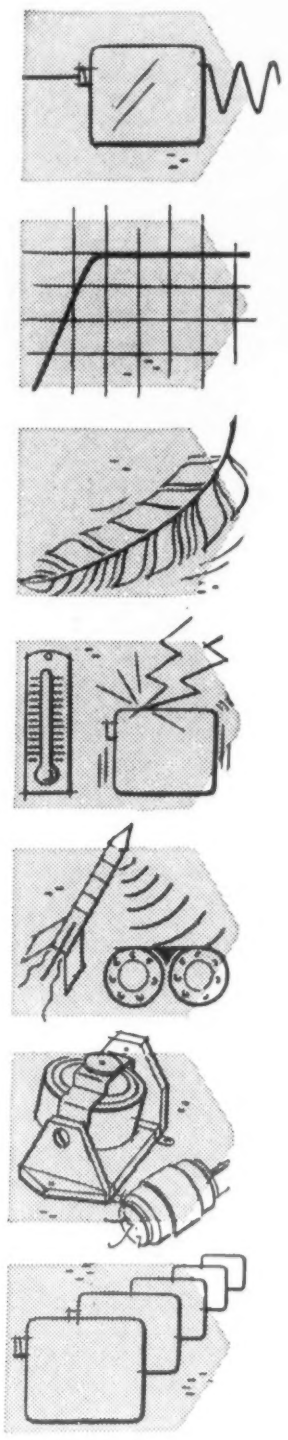

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Light weight (to 6 watts/oz.), compact (to 8 watts/cu. in.), low ripple (to 0.01 mv. p-p), excellent voltage regulation (to 0.1%), precise frequency control (to 0.2% with Interelectronics extreme environment magnetostrictive standards or to 0.0001% with fork or piezoelectric standards.)

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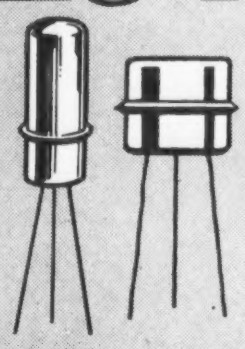

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SURFACE BARRIER TRANSISTORS (SBT)**

TYPE	GAIN h_{fe}	FREQUENCY f_{max} in mc	APPLICATIONS
2N128	40	60	General communications; specifications
2N240	30	Switching rates 20mc	High-speed switch; controlled storage and saturation charac istics; MIL specifications
2N344	22	50	General purpose; narrow spread (11-33)
2N345	35	50	General purpose; similar to 2N with higher beta
2N346	20	75	General purpose; like 2N344 2N345 but higher frequency

MICRO ALLOY TRANSISTORS (MAT*)

TYPE	GAIN h_{FE}	FREQUENCY f_{max} in mc	APPLICATIONS
2N393	95	60	High-speed, high-gain switch; specifications
2N1122	Min 25	60	High-voltage, high-speed sw
2N1122A	Min 25	60	Higher voltage version of 2N1
2N1411	75	f_T 60	High frequency switch MIL sp
2N1427	75	f_T 75	General purpose, high-sp switch

MICRO ALLOY DIFFUSED-BASE TRANSISTORS (MADT*)

TYPE	GAIN	FREQUENCY f_{max} in mc	APPLICATIONS
2N499	10 db @ 100 mc	320	VHF amplifier; MIL specificati
2N501	h_{FE} 35	Switching rates 20 mc	Ultra-fast switch; typical t_r mμsec, t_s 7 mμsec, t_f 7 mμsec
2N501A	h_{FE} 35	Switching rates 20mc	Rated at 100°C; MIL specificati
2N502	10db @ 200 mc	650	VHF amplifier
2N502A	11.5db @ 200 mc	750	Rated at 100°C; MIL specificati
2N503	12.5db @ 100mc	420	VHF amplifier
2N504	46db @ 455kc	Minimum 50	IF amplifier; high level logic swi
2N588	14db @ 50mc	250	General purpose RF-IF amplif
2N1158	25mw PO	at 200 mc	UHF power oscillator
2N1204	h_{FE} 60	f_T 400	High current switch & core dri
2N1494	h_{FE} 60	f_T 400	High current, high power swi & core driver
2N1495	h_{FE} 60	f_T 400	Higher voltage version of 2N12
2N1496	h_{FE} 60	f_T 400	Higher voltage version of 2N14
2N1499	h_{FE} 35	Switching rates 5 mc	High-speed, saturated switch
2N1500	h_{FE} 50	Switching rates 20 mc	Ultra-fast switch; typical t_r mμsec, t_s 7 mμsec, t_f 7 mμsec

MINIATURE TRANSISTORS

TYPE	GAIN h_{fe}	FREQUENCY $f_{\alpha b}$ in mc	APPLICATIONS
2N207	100	2	Low level amplifier; particula suited for hearing aid use; N. 15db max

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†Noise Figure at 1 μv reference level across 1,000 ohms

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MINIATURE TRANSISTORS

TYPE	GAIN h_{fe}	FREQUENCY $f_{\alpha b}$ in mc	APPLICATIONS
2N207A	100	2	Low level amplifier; particularly suited for hearing aid use; N.F.† 10db max
2N207B	100	2	Hearing aid input stage; other extremely low noise applications; N.F.† 5db max
2N534	100	1	High voltage amplifier switch
2N535	100	2	Low-level amplifier and switch; N.F.† 10db max.
2N535A	100	2	Low-level amplifier and switch; N.F.† 5db max.
2N535B	100	2	Low-level amplifier and switch; N.F.† 0db max.
2N536	h_{FE} 150	2	Low level switch at pulse rates up to 150kc

SILICON SURFACE ALLOY DIFFUSED-BASE TRANSISTORS (SADT*)

TYPE	GAIN h_{fe}	FREQUENCY	APPLICATIONS
2N1199	h_{FE} 25	f_T125mc	NPN high-speed silicon switch; max t_r 70 mμsec, t_s 20 mμsec, t_f 40 mμsec
2N1267	11	24db at 4.3mc	NPN silicon amplifiers and oscillators
2N1268	20	25db at 4.3mc	
2N1269	50	26db at 4.3mc	
2N1270	11	24db at 12.5mc	NPN silicon amplifiers and oscillators
2N1271	20	25db at 12.5mc	
2N1272	50	26db at 12.5mc	
2N1472	h_{FE} 35	Switching rates 5mc	NPN high frequency silicon switch

SILICON SURFACE ALLOY TRANSISTORS (SAT*)

TYPE	GAIN h_{FE}	FREQUENCY f_T in mc	APPLICATIONS
2N495	h_{fe} 20	f_{max} 21mc	General purpose; MIL specs
2N496	16	20	High-speed switching; MIL specs
2N1118	h_{fe} 20	f_{max} 18mc	General purpose; MIL specs
2N1118A	h_{fe} 25	f_{max} 18mc	General-purpose amplifier, high beta (15-35)
2N1119	16	20	High-speed switching; MIL specs
2N1428	30	35	General purpose, low-cost, high-frequency, silicon amplifier and switch; TO-1 case
2N1429	30	35	Electrical equivalent of 2N1428 in TO-5 case

MEDIUM FREQUENCY TRANSISTORS

TYPE	GAIN h_{FE}	FREQUENCY $f_{\alpha b}$ in mc	APPLICATIONS
2N597	70	8	High-voltage general purpose amplifier and switch
2N598	125	10	400kc logic switching
2N599	175	18	Logic switching rates up to 1mc; core driver; MIL specifications
2N600	125	10	500kc switching; 1 watt peak power dissipation for 0.1 sec; stud mount

MEDIUM FREQUENCY TRANSISTORS

TYPE	GAIN h_{FE}	FREQUENCY $f_{\alpha b}$ in mc	APPLICATIONS
2N601	175	18	High-power core driver; typical rise time 0.1 μsec; stud mount
2N1123	70	5	High-voltage power amplifier and switch; stud mount
2N1478	70	8	300kc switching applications

PULSE AMPLIFIER TRANSISTORS

TYPE	GAIN h_{FE}	FREQUENCY $f_{\alpha b}$ in kc	APPLICATIONS
2N670	$\overline{h_{fe}}$ 100	700	High peak current pulse amplifier; relay driver
2N671	100	700	High power version of 2N670; stud mount
2N672	Min 20(SAT)	0.5 μsec max t_r	High-current switching core driver; controlled rise, fall and store times
2N673	Min 20(SAT)	0.5 μsec max t_r	High power version of 2N672; stud mount
2N674	$\overline{h_{fe}}$ 100	min 400	75 volt version of 2N670
2N675	100	min 400	75 volt version of 2N671

MEDIUM POWER TRANSISTORS

TYPE	GAIN h_{FE}	FREQUENCY $f_{\alpha b}$ in mc	APPLICATIONS
2N223	h_{fe} 110	0.6	Audio driver; exceptional beta lin..
2N1416	h_{fe} 110	0.6	Matched pair of 2N223's
2N224	90	0.51	Audio output; exceptional beta linearity
2N225	90	0.51	Matched pair of 2N224's
2N226	60	0.4	Audio output and switch; exceptional beta linearity
2N227	60	0.4	Matched pair of 2N226's
2N1124	h_{fe} 100	1	High-voltage, general-purpose industrial amplifier and switch
2N1125	$\overline{h_{fe}}$ 75	1.6	High-voltage, medium-frequency amplifier and switch
2N1128	h_{fe} 100	1	Exceptionally linear beta; audio driver and output
2N1129	165	0.75	General-purpose, high beta, audio and switch
2N1130	125	0.75	General-purpose audio and switch; exceptional beta linearity

POWER TRANSISTORS

TYPE	GAIN	FREQUENCY $f_{\alpha e}$ in kc	APPLICATIONS
2N386	33db at 5w PO	14	High-voltage, high-power amplifiers, servo amplifiers, converters and switches
2N387	33db at 5w PO	12	High-voltage, high-power amplifiers, servo amplifiers, converters and switches

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— GOVERNMENT —

PROJECT TRANSIT is the United States' experimental navigation satellite presently orbiting the earth in an effort to provide a more accurate means of maritime and aerial navigation than is now available under any weather conditions. Launched April 13 from Cape Canaveral, Florida, Transit I-B can provide a reliable global all-weather means of fixing the position of surface craft, submarines and aircraft. The feasibility test of the navigational system is based on the capacity of the six ground receiving stations and computing center to extract positional information from Transit's signals. Transit transmits on four widely separated frequencies (54-324, 162 and 216 mcs) to provide broad experimental control. The change in frequenc of the signal is checked automatically by a ground station against a time and frequency standard. This information then is teletyped to a computer center where the satellite's position can be accurately computed.

NATIONAL BUREAU OF STANDARDS has set up a radio station at Sunset Canyon, near Boulder, Colorado, to provide transmission of signals on the very low frequency of 20 kilocycles. These signals will be used by research organizations in studies to prepare for the eventual installation of a 300 kilowatt transmitter which would provide world-wide coverage. The 20 kilocycle signals, which should provide coverage as far as Alaska and Hawaii, will serve as frequency standards and later will measure time intervals. Established by the NBS Radio Standards Division, the Sunset installation sent its first signals April 5.

NEW CHAIRMAN OF ARMY SCIENTIFIC ADVISORY PANEL is Dr. Clifford C. Furnas, Chancellor of the University of Buffalo, Buffalo, New York, and former Assistant Secretary of Defense for Research and Development. A member of the panel since September 1958, Dr. Furnas succeeds the late Dr. James W. McRae, who died recently. The panel includes 60 scientists, industrialists and educators who advise the Secretary of the Army and the Army Chief of Staff on the Army's research and development program.

SEVERAL DEVELOPMENTS IN NAVY'S POLARIS have taken place recently. (1) The Defense Department has asked Congress for $39 million to start building six more Polaris submarines. (2) A third class of Polaris subs, SSBN-616, which will have the newest weapon system and improvements evolved from the earlier classes, will be built by th Electric Boat Division of General Dynamics Corp. under a Navy contract. (3) Serving as a link between Polaris industrial producers and the fleet, the Polaris missile assembly facility of the Naval Weapons Annex began operations April 1 at Charleston, South Carolina. (4) The Navy and Aerojet-General Corp. have developed a new process for manufacturing solid propellant fuel for the Polaris missile.

AUTOMATION AT THE ARMED SERVICES TECHNICAL INFORMATION AGENCY, Arlington Hall, Va., is helping to expedite research work on the nearly one million documents in the ASTIA collection, which is growing at the rate of 30,000 titles per year. ASTIA, which provides Defense agencies and their contractors, on request, with copies of research reports done by or for the military agencies, installed a Remington-Rand USS-90 (Univac Solid State Computer) in February as the first step in its automation program. Within a year, ASTIA hopes to copy all catalog cards on magnetic tape, making possible automatic printout, at 600-lines-per-minute, of bibliographies, together with a full descriptive abstract of each reference.

ARMY ELECTRONIC EAR said to be keen enough to pick up faint radio signals from inter planetary rockets has been revealed. The super detector, developed for the U. S. Ar Signal Corps by Hughes Aircraft Co., is being tested at the U. S. Army Signal Resear and Development Laboratory, Fort Monmouth, New Jersey. Used as an amplifier for rad and radar, the 25-pound device can detect signals from space vehicles and stars millions of miles away. The device also will enable U. S. military defense systems usi long-range, high-angle radars to detect intercontinental ballistic missiles earlier than they can now and it will be used to increase the range of communications betwee future manned space vehicles.

FEDERAL COMMUNICATIONS COMMISSION CHAIRMAN made some interesting comments when he addressed the National Association of Broadcasters in Chicago, April 5. Speaking about the FCC's role in broadcasting, Frederick W. Ford said, "In general, when the Commission is faced with a problem indicating the need for corrective action, the fundamental question in my mind is not whether the Commission has the authority to take action, but it is to determine precisely what remedy is required and whether it is the Commission's responsibility to apply that remedy. If . . . further statutory authority is needed before the remedy is applied, it becomes the Commission's obligation to inform the Congress of that fact and propose the necessary legislation." In discussing the extent of "payola" practiced by stations, the recently appointed chairman noted, "4,131 or 88 percent of the radio and television stations on the air . . . received no 'payola' or it was limited to free records which were not announced at the time they were played on the air as being furnished. This leaves 515 or 11 percent of the stations on the air in which the station or its employees had received cash or other consideration for broadcasting material without the required announcement having been made."

ARMY COMPUTER TECHNIQUE has been perfected which can calculate swiftly radio propagation data such as the maximum usable frequency and the lowest useful high frequency for any radio skywave path. Developed by the U. S. Army Radio Propagation Agency at Fort Monmouth, New Jersey, the technique is applicable to large scale general computers. The technique requires only about four minutes to determine the radio information.

NATIONAL SCIENCE FOUNDATION will give grants totaling approximately $275,000 to colleges and universities in support of sixteen Summer Conferences for College Teachers of Science and Mathematics. The conferences, which will last four weeks or less, are designed to strengthen the teachers' mastery of newer developments in science and mathematics and to help increase their effectiveness in the classroom.

CONTRACTS: ARMY: Raytheon Co., for production of additional Army Hawk missile ground support equipment, $12,500,000; General Dynamics Corp., Convair Div., for development of new mobile battlefield air defense missile system known as Mauler, which will use radar-guided missiles, $5,500,000; Fairchild Camera & Instrument Corp., for two test models of a drone photographic surveillance system, $1,998,000; Western Electric Co., for Nike-Zeus communications and instrumentation facilities for testing the weapon on Kwajalein Island. NAVY: General Electric Co., Light Military Electronics Dept., for continued production of the Sidewinder air-to-air guided missile, $4,895,000; Motorola Inc., Military Electronics Div., for production of 484 all-transistorized 10-inch radar repeaters, $2,453,608. AIR FORCE: Sylvania Electric Products Inc., for development and production of a ground countermeasures receiving system, about $7,000,000; Westinghouse Electric Corp., for a microwave communications system using frequencies between 1700 and 2300 megacycles to be installed in Italy, about $1,000,000. MARINE CORPS: Collins Radio Co., for the manufacture of additional single sideband communications systems for jeep and truck mounted installations, about $21,000,000.

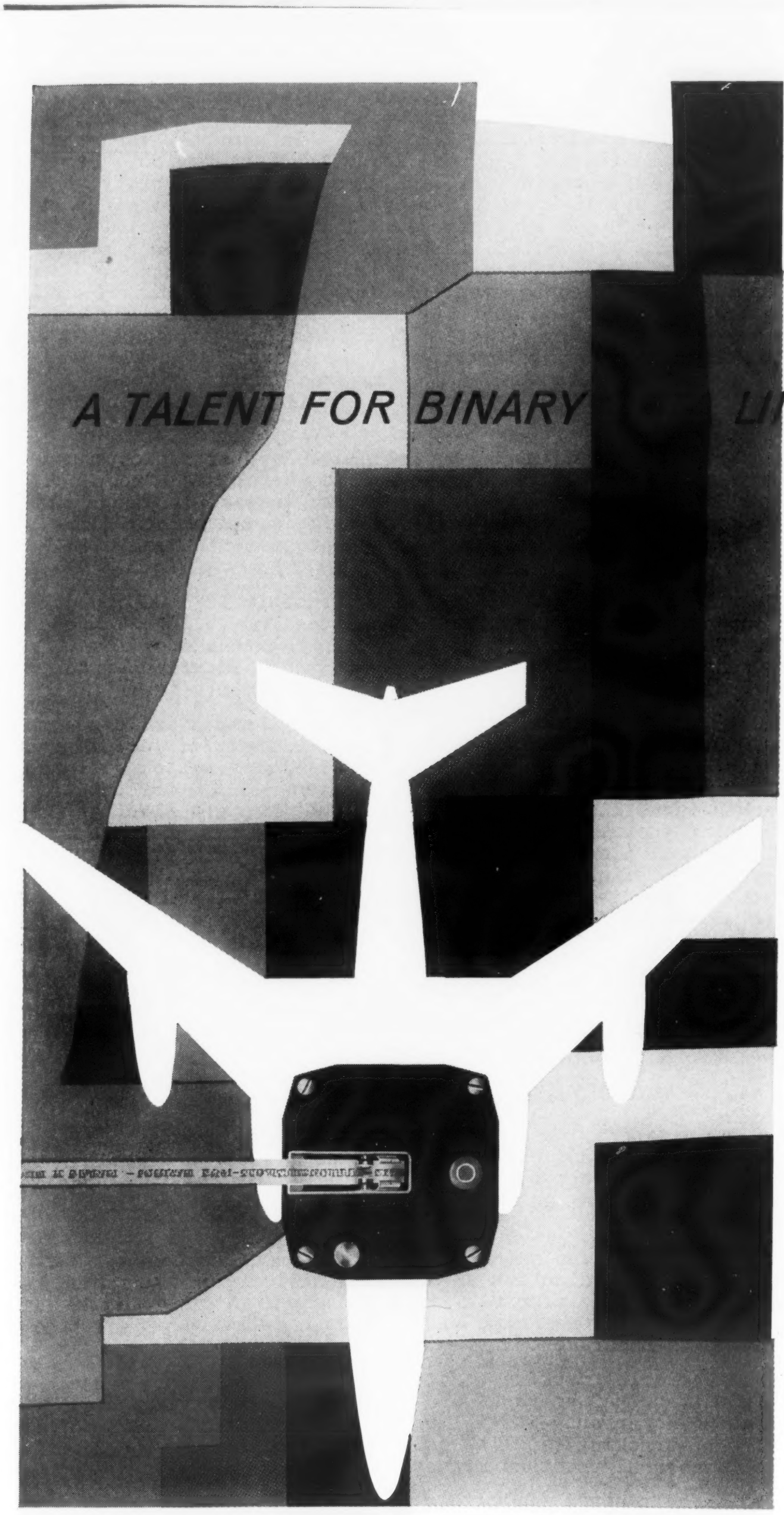
— INDUSTRY —

NAME CHANGE will be put in effect about June 1 whereby "The Bendix Corporation" will replace "Bendix Aviation Corporation" as the corporation title. Stockholders voted the name change to provide a correct picture of the firm's diversity. Bendix is engaged in the manufacture and sale of automotive, electronic, nuclear, missile, industrial and aviation products.

HUGHES AIRCRAFT CO. has opened an advanced radar test center in Carbon Canyon, California. The $225,000 center for the evaluation of advanced military radar system has a 4,000-foot antenna pattern range. The transmitter and receiver of the antenna pattern range are located on separate 870-foot high hilltops in a relatively isolated, interference-free region near the radar center.

ALPHA CORP. has built a transportable tracking station which is said to be capable of tracking up to 10 million miles. After tests are completed on the station—now at the firm's Dallas, Texas, headquarters—it will be disassembled for delivery to a yet to be determined site. The tracking facility can be modified to receive signals ranging from 20 megacycles to several thousand megacycles, it is said.

DAYSTROM ASW UNIT, designed to help naval officers perfect themselves in techniques of anti-submarine warfare tactics before they go to sea, has been shipped to the Japanese Staff College at Kodaira, Japan, by Daystrom, Inc. Known as the Action Speed Tactical Trainer, the unit was developed by Daystrom in collaboration with the U. S. Naval Training Devices Center and is being made available to the Japanese through the Military Defense Alliance Assistance program. (*Continued on page 59*)



A TALENT FOR BINARY LINK SYSTEMS

The application of binary data link transmission to large or small radio networks is made feasible by the Stromberg-Carlson Automatic Binary Data Link.

The broad capabilities of the equipment include:

- 5-character alphabetical address, providing over 11 million private addresses;
- automatic response to interrogation, which provides a 5-character alphanumeric message useful for indicating any element of a status report such as altitude, heading, position.
- Tape readout in the airborne unit.

Detailed information on request.

STROMBERG-CARLSON
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1400 N. GOODMAN STREET • ROCHESTER 3, NEW YORK

S-C

Signalgram (*Continued from page* 57)

AT THE ELECTRONIC INDUSTRIES ASSOCIATION DEFENSE SEMINAR held recently in Washington, D. C., several points of interest were made. (1) John M. Sprague, Deputy Assistant Secretary of Defense (Comptroller) noted that "The heart of the problem within the Defense Department is to provide adequately for the national security by achieving, within the resources that are available, the best possible balance among combat forces in being, the procurement of hardware for these forces and the research and development of new weapons systems for the future . . . There is no question but that the 1961 budget reflects some very hard choices. But in the judgement of the President and the Secretary of Defense, the 1961 defense budget does provide for those programs which are essential to our national security." (2) RAdm. L. D. Coates, Director of Development Planning, Office of Chief of Naval Operations, foresaw a possible increase of 20 percent in the electronic industry's share of the defense budget during the next 10 years. He said the industry's share of defense money increased from $560 million in 1950 more than 10 times to a total of $5.935 billion in 1959. (3) Dr. Richard C. Raymond, Manager, Technical Military Planning Operation, General Electric Co., stated that the problems of national defense are so numerous and complex and the need for continuous progress is so great that the nation "must not turn down any promising idea without some exploration . . . . It is probably more economical in the long run to tolerate some degree of overlapping and duplication than it is to argue out each case and then to build obsolete equipment on the basis of the agreements."

MELPAR, INC. has established a Special Products Department to apply the company's technology and experience to the development and production of a line of products to be made available to the military, to prime contractors for military business and to commercial organizations.

A CONTRACT IN EXCESS OF ONE MILLION DOLLARS has been received by Canoga, a subsidiary of the Underwood Corporation, for the design and manufacture of all ground based telemetry, communications and command control antennas for the NASA Project Mercury. "Our work will be coordinated closely with the efforts of Cubic Corporation, Bendix Radio, Western Electric, IBM, NASA and MIT's Laboratories in the program," Canoga president George H. Nibbe said.

CONSOLIDATED ELECTRODYNAMICS CORP., DataTape Div., has supplied magnetic tape recorder/reproducers for recording analog data in satellite tracking trailers. The tracking complex consists of several trailers designed for airlifting. Each complex will be equipped with two DataTape recorder/reproducers designed to handle a broad range of data.

SYLVANIA ELECTRIC PRODUCTS INC. has received a $600,000 Navy contract for production of low-altitude radar altimeters for helicopter use. The altimeter, designated the APN-117, is the first military low-altitude unit designed for use in helicopters. It was developed by Sylvania in conjunction with the Bureau of Naval Weapons, which made the contract award. An earlier production contract was awarded in Sept., 1958.

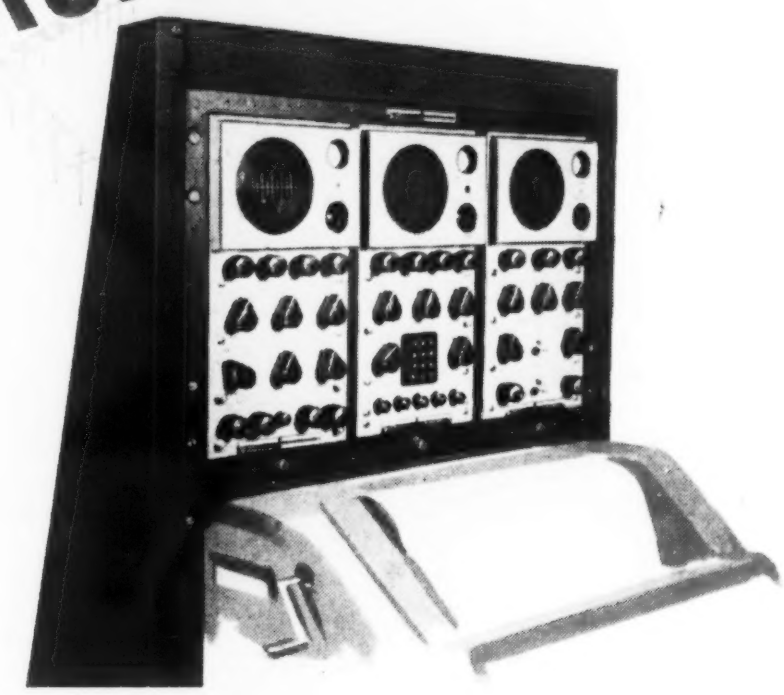
— GENERAL —

PHOTO CONFERENCE of the Society of Photographic Scientists and Engineers featured technical papers on various aspects of photographic science and related engineering, May 9-13 at the Miramar Hotel in Los Angeles. Subjects included optics, camera and equipment design, photosensitive systems and the use of photography in the growing field of scientific and engineering recording and measurement.

SOUTHERN ITALY will be the site of a multi-million dollar electronics manufacturing complex as a result of an agreement signed by an Italian state agency, Instituto per la Ricostruzione, and RCA International, Ltd., of Montreal, a subsidiary of Radio Corporation of America. The principal purposes of the international development program are to expand Italy's electronics business in the European Common Market, to assist the industrialization of the southern section of Italy and to encourage private capital to invest in manufacturing enterprises in Italy. In the initial phase of the program, facilities for the manufacture of tubes and semiconductors will be expanded. Later the program will encompass other fields of electronics. (See page 24)

FAR INFRARED SCANNER which is adaptable for anti-intercontinental ballistic missile guidance or interplanetary navigation has been designed and built by the Baltimore Division of The Martin Co. The 50-pound unit permits detection of objects having very low temperatures such as the temperature of a satellite's outer skin surface. As a space navigation instrument, the unit could be used to detect infrared rays emanating from the stars, planets or satellites. Using a 12-inch aperture, the unit is equipped with an advanced optics system and a series of highly sensitive supercooled detectors in combination with low-noise amplifiers. (*Continued on page* 61)

ANALYZE THE TROUBLE WITHOUT INTERRUPTING TRAFFIC



how to reduce down-time on telegraph and data transmission circuits

Radiation's new Telegraph Distortion Monitoring System (TDMS) provides in one compact assembly complete testing, monitoring and signal waveform analyses of telegraph circuits and data transmission lines. This versatile unit makes possible on-line quality control of communications links. It indicates malfunctions, analyzes their causes—without interrupting the flow of traffic.

The Radiation TDMS, with miniaturized components for space-saving compactness, can replace most test equipment now required for teletype maintenance and monitoring. Thus, in addition to reducing circuit outage, the TDMS permits reduction of test equipment costs and increases maintenance efficiency. Portability is achieved at the "push of a button".

For a detailed description of the operation and capabilities of the TDMS, write for Brochure RAD E-100B. Address Radiation Incorporated, Dept. S-4, Melbourne, Fla.

THE ELECTRONICS FIELD ALSO RELIES ON RADIATION FOR . . .

RADIPLEX—50—channel low-level multiplexer with broad data processing applications. Features rugged solid-state circuitry, almost unlimited programming flexibility, unique modular construction for compactness and exceptional ease of operation and maintenance.

RADICORDER—Multistylus recorder provides high-speed instantaneous readout for wide range of data acquisition or processing systems. Eliminates necessity of electronically translating complete data, thereby reduces computer work loads.

TELEMETRY TRANSMITTER—Model 3115 is a ruggedized 215-260 MC unit with extremely linear FM output under the most severe environmental conditions. With its record of outstanding performance in many missile programs, Model 3115 is specified by leading missile manufacturers.

RADIATION INCORPORATED

See this equipment demonstrated at AFCEA. Booth numbers 71-72

Signalgram (*Continued from page 59*)

OPTICAL SOCIETY MEETING featured the latest precision optical mechanisms for use in the laboratory, in astronomy and for measuring the ultraviolet and infrared regions. Scientific papers presented at the meeting, sponsored by the Optical Society of America at the Statler Hilton Hotel in Washington, D. C., April 7-9, covered a wide range of topics including discussions of the optics of outer space and the 600-foot radio telescope.

A COMPANY PUBLICATION listing the meeting dates of 24 professional organizations and the deadlines for papers to be presented at these meetings may be made available to technical societies. Presently, Space Technology Laboratories, Inc. distributes its monthly LIVE DEADLINES to STL technical and professional personnel to encourage them to prepare technical papers.

PAY-TV may be given a three year trial run in Hartford, Connecticut. Zenith Radio Corp. and RKO General, Inc. have completed arrangements whereby RKO will conduct the trial run and Zenith will provide its "over-the-air" Phonevision system. RKO General has applied to the Federal Communications Commission for authorization to conduct the subscription television trial run. Since this authorization must be obtained before the tests can begin, no precise date has been set for initiating the Hartford operation. The station chosen for the tests will broadcast sponsored and sustaining programs during most of the day. For a few hours each day, the station will operate on a subscription basis, presenting without commercials "major box office features not shown on regular TV."

STOCK MARKET INCREASES were described by Keith Funston, President, New York Stock Exchange. He observed, "Between 1952 and 1959 the number of individuals who own shares of publicly-held companies nearly doubled—to a total of 12,500,000. If shareownership continues to expand soundly—and we have every reason to hope that it will—we could have a stockholder population of 22,000,000 by 1970."

SYNCHRONIZATION OF SATELLITE TRACKING CAMERAS spaced 200 miles apart to within one ten-thousandth of a second was described by John Shannon, Senior Engineer of the Electronic Engineering Company of California, in a paper at the Winter Convention on Military Electronics. The Ballistic Camera Synchronization System was designed in cooperation with the Ballistic Research Laboratory, Aberdeen Proving Ground, Md., for the Army Ordnance Corps and developed and built by EECo. The system, which consists of a central camera control station and two remote control stations, was delivered in December, 1959, to the Army Ballistic Missile Agency.

A TELEVISION SYSTEM that can transmit maps, charts and pictures over long distance telephone lines was demonstrated for the first time at the Air Research and Development Command's Rome Air Development Center. In order to transmit the picture over telephone lines, the wide television signal is reduced to the narrower band width of telephone lines. The reduction is made possible through the use of "scan-conversion storage tubes" that convert signals from an industrial television camera to the narrow band capacity of commercial telephone lines. The narrow band signal is reconverted to wide band at the receiving end. The system was built by International Telephone & Telegraph Corp. in cooperation with ARDC.

MANUFACTURER'S REPRESENTATIVES for electronic test instrument companies are increasing at a rapid rate, according to study conducted by Technical Information Corp. The study revealed that the number of offices of test instrument representatives increased 67.7 percent from 1957 to 1959. The increase "mirrors not only the major role of test instruments but the expansion of the electronics industry itself," according to a TIC official.

BRITISH IMAGE INTENSIFIER is said to intensify light 50,000 times. The experimental device illuminates optical images invisible to naked eye so that the images can be photographed. Intensifier applications are expected in astronomy, nuclear physics and hospital X-ray examinations. Developed at Department of Instrument Technology of Imperial College of Science in London, the Intensifier permits photographing of sky bodies by almost instantaneous snapshot-like exposure, largely overcoming problem of local disturbances in earth's atmosphere encountered with lengthy telescope-exposure.

CALENDAR OF EVENTS:

MAY 23-26: Design Engineering Conference, American Society of Mechanical Engineers, Coliseum, New York City.

MAY 23-28: Instruments, Electronics and Automation Exhibition, Industrial Exhibitions Ltd., Olympia, London, England.

MAY 31-JUNE 2: Frequency Control Symposium, U. S. Army Signal Research and Development Laboratory, Shelburne Hotel, Atlantic City, New Jersey.

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In today's scientific and technological expansions, no single co
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munications company, enjoys the idea-exchanging of more
7,100 scientists and engineers working in 101 ITT laboratorie
plants in 20 countries.

This global capacity encompasses a lot. From miniaturized compo
to complete systems for wire and radio telecommunications.

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gle countr ata-processing and advanced computing
s and cor equipment to missiles and air navigation.
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AFCEA SHOW VISITORS
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BOOTHS 82 to 87

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Electronic Development

(*Continued from page 25*)

as microwave components, an up-to-date capability is being developed by smaller Italian companies. Moreover, the large power-producing companies, faced with a tremendous expansion of their distribution systems, and now also involved in nuclear power plants, have organized their own instrumentation research groups to satisfy their internal needs. These groups are, as a consequence, producing a few specialized instruments for general sale.

In the development and production of ordinary communications systems of all types, Italian industry is quite active and competent. However, in research, their activities are most interesting in the fields of microwave system design and antennas. This is chiefly the result of the excellent Microwave Center in Florence, which probably has the best equipped laboratory in the Italian university system. There is also a considerable amount of work in propagation measurement, both purely within Italy and as a part of general European programs under NATO sponsorship. Italian physicists have a long tradition in optical physics where they continue to do outstanding work.

Radar serves as a good illustration of the general pattern of the many large electronic system developments which have been supported in other Western European countries primarily by military agencies. Security limitations of many types have prevented Italian developments from keeping pace with the advanced systems used in the United States. However, Italy is quite up-to-date on commercial radar and, not only are most of its own marine radar needs handled internally, but also on a few occasions Italian groups have designed commercial radars for production and sale by American companies.

France

Although France was a victor in the war, her industry was almost destroyed. Her research, development, and production potential are only now beginning to come back. France's emergence after the war was handicapped by lack of equipment, money, and people. It was not until 1948 that French industry began to recover. Since then, tremendous strides have been made. France had an advantage in that many of its engineers and scientists had taken part in, or were familiar with, Allied war developments.

French naval electronic laboratories have contributed a number of important improvements to the art. These developments are not overpublicized, and for security reasons cannot be discussed.

French industry is also contributing amounts to military electronics. Thompson Heutan, French G.E., Edison and C.S.F. all have thriving businesses, both in research and development, and in production.

C.S.F. (Compagnie Generale de Telegraphie sans Fils) is well known in the United States for its development and uses of traveling wave tubes, notably the carcinatron. The company also manufacturers and develops an improved klystron and magnetron. It probably has done as much as anyone in microwave communications. It has built microwave links throughout the Continent and Africa. It has close working agreements with Italian industry and either exports or licenses the developments from Italian laboratories.

Considerable work is being done on infrared. However, in France, as in Germany, infrared developments tend toward the high frequencies. Devices are being developed for high reconnaissance. The Navy is very much interested in infrared to guard a long and much broken coastline against marauders, submarines, smugglers and saboteurs. She has made steady improvement over the type of sniper-scope which the American forces used during the war. Her development of television quality is excellent. The total level of research and development effort in France is of a lesser volume per capita than of England or Germany, but substantially higher than in Italy.

Switzerland and Holland

Switzerland and Holland have had sensational developments in electronics due to the work of the Oerlikon Company of Zurich and the Phillips Company of Eindhoven.

The Oerlikon Company was a major producer of munitions before, during and after the war, and it continues to be today. Its electronic devices are ingenuous, economical, and reliable. It builds missiles, guided missiles, shells, tanks, guns, electronic gun predictors, and computers—in fact, a complete line of military electronics.

Oerlikon has had great success with such commercial electronic devices as computers, bus equipment, signals, etc. Many of the company's devices would be competitive in the United States, except for tariff regulations and security restrictions. They continue to sell military electronic equipment all over the world (with t possible exception of Russia) and the NATO countries.

In Holland the Phillips Company Eindhoven is one of the great ele tronics laboratories in the world. U fortunately, very little is known of i developments since company securi is closely maintained over all oper tions. The company pioneered in fe rites and other magnetic phenomen It is probably the most important ele tronic company in Western Europ Its equipments are used througho the world. There is probably no ar of electronics in which this compar is not engaged. Phillips carries o her development in electronics ar physics without government suppor

Sweden

Sweden is very active in militar and commercial electronic develo ment. Her government gives a su stantial portion of her income to la oratories and schools. Consider wh this small country has done on he own in recent years. She designe developed, and built a superson fighter aircraft, complete with a electronics. She develops, produce and sells two automobiles. Her ant aircraft guns and aircraft, for the caliber, are considered equal to an thing in the world. She builds rocke and small missiles. She also sel munitions throughout the worl Sweden's electronic development i education, military and commercia is probably as great per capita as i any country of Western Europe.

Such investigations as I was abl to make of the Swedish universitie and research laboratories indicate a sound, dedicated approach to ele tronics and physics. I do not believ the developments are as far along a our own, or as sophisticated, but the are good and they are impressive Sweden, of course, has had the ad vantage of being at peace during tw World Wars.

Summary

To summarize, electronic develo ment in Western Europe is progres sing rapidly and should be of increas ing interest to the United States Whereas Westren Europe will be in creasingly competitive, it will als contribute substantially to the im provement of the art, and as such, t mankind.

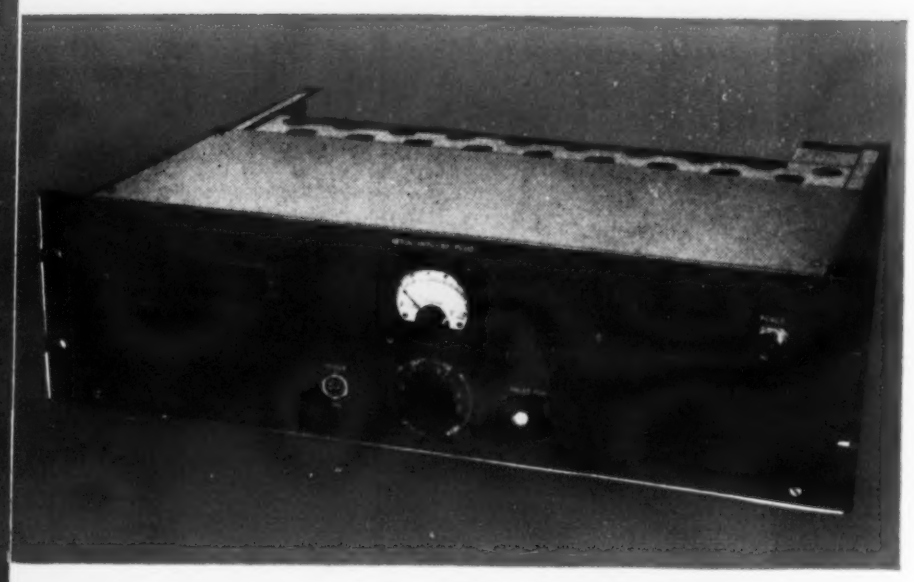
In general, electronics in Europ leans toward more reliable and sim pler devices. The amount of basi research being done is increasing an this should be of help to us in ou efforts to keep pace with the advance being made by Russia.

Plessey

HF and VHF Aerial Multicouplers

PV14 SERIES and PV95A

Aerial multicouplers are now general practice in communications systems to decrease capital expenditure on aerials. Plessey has wide experience of HF and VHF communications systems and the multicouplers described below are manufactured to very high standards; they are in worldwide use by communications networks, the British Armed Forces, many NATO countries, civil aviation authorities and press agencies. Prices are competitive.



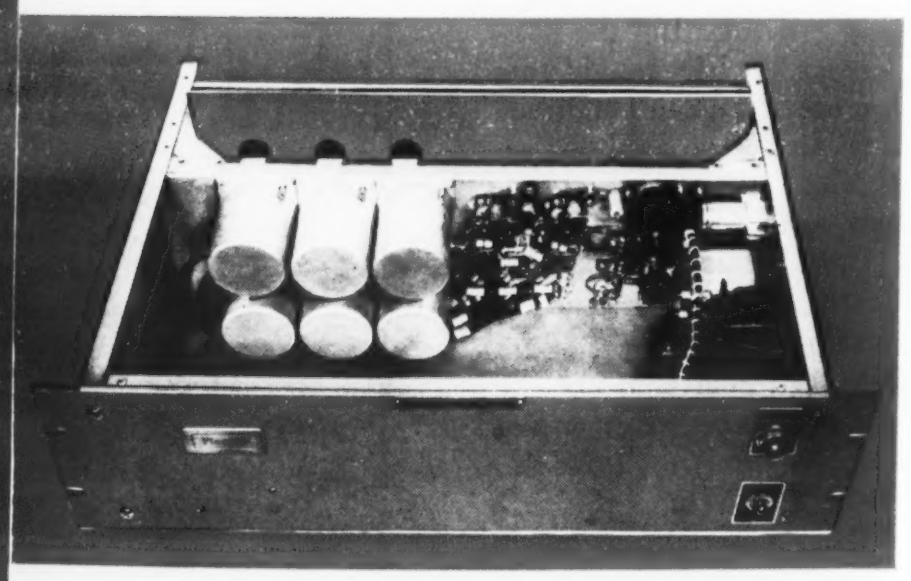
Features
- *Fully compensated* aperiodic amplifiers
- *Preset Switch* for dual diversity or single input operation
- *Low Noise Factor*
- *Minimum Cross Modulation*
- *Monitoring of each stage* by built-in meter
- *Low cross coupling* between output sockets

PV14 SERIES — HF AERIAL MULTICOUPLERS

This equipment has been designed to meet the stringent requirements of both military and civil communication organisations, either from two aerials as a five-channel amplifier for diversity working or from one aerial as a ten-channel amplifier over the frequency band 2-30 Mc/s. The equipment is fully suitable for ground station or transportable use.

Specification

Frequency Range	2-30 Mc/s
Insertion Loss	0 dB +4.5 dB −3 dB over frequency range
Noise Factor	Maximum of 14 dB
Input and Output Impedance	75 ohms Nominal unbalanced
Regulation	A change in loading from 2 to 10 sockets will not reduce the gain by more than 3 dB
Power Supply	105 V, 115 V, 200-250 V, 40-60 c/s a.c.
Ambient Temperature Range	−20°C to +55°C
Dimensions	19 in. wide x 5¼ in. high x 12 in. deep (48.3 cm x 13.3 cm x 30.5 cm)
Weight	28 lb. (12.7 kilos)



Features
- *Low Noise Factor*
- *Low Cross-Coupling* between output sockets
- *Wide Band Amplifier*
- *Minimum Cross Modulation*
- *Self-contained Power Supply Unit*

PV95A VHF MULTICOUPLER

This unit again has been designed to meet various requirements over the VHF band of 100 to 156 Mc/s and provides outputs for up to six receivers when fed from a single aerial. In the design of this equipment, emphasis was placed on low noise factors and minimum cross coupling, using the wide band amplifier technique. The equipment is designed for ground station or transportable use.

Specification

Frequency Range	100-156 Mc/s
Insertion Gain	Greater than 10 dB over the whole range
Noise Factor	11 dB or less 100-108 Mc/s 10 dB or less over rest of range
Input and Output Impedance	75 ohms unbalanced
Power Supply	105 V, 115 V, 200-250 V, 40-60 c/s a.c.
Ambient Temperature Range	−20°C to +55°C
Dimensions	19 in. x 5¼ in. panel x 13 in. deep (48.3 cm x 13.3 cm x 33.0 cm)
Weight	15 lb. (6.8 kg)

The overseas selling organisation of The Plessey Group of Companies

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PIL/T/4

Changing Shape of Electronics

(*Continued from page* 30)

temporarily detracted from the prestige of people most familiar with the art—communications people. The excitement of new words—Radar, Sonar, Proximity Fuse, Loran, Computers and others—tended to relegate the communicators to association with telephony, telegraphy and radio—which the newcomers to electronics accepted as static or obsolete arts soon to be overshadowed by the "great new discoveries."

These newcomers have now had a startled awakening. They have found that the most effective use of the new discoveries is accomplished when they are all linked together in one coordinated system. To what group do they look to accomplish this complex task? The communications people. A signal is still a signal as it always has been—an electrical impulse that travels with the speed of light—from point to point—by radio—by wire—through endless space, or from one contact to another in a tiny micromodule.

So has dawned the realization that every form of communications has as its basic common denominator a signal—be it radar, facsimile, radio, computers, teletype, automation, navigation or whatever. All are simply the proper control of signals—generated at one point and utilized at another point.

This growing concept at all levels of national defense, commercial and industrial operations is generating such revolutionary suggestions as a unified, single service, world-wide communications system for the military. It is the moving force behind the revitalization of the telegraph industry. It spawns such programs as a nation-wide network for data processing and weather maps. It leads to proposals such as a Defense Secretary for Electronics and Communications or even a cabinet officer for Electronics and Communications.

As these ideas become more prevalent we shall see the prestige and the importance of communicators rise to the greatest heights of all time. Communications means control—the only coordinated control possible in our complex world and universe.

Communications under this concept is a living, growing, healthy force, with a future unexcelled by any other field of endeavor. The nuclear and space age will be controlled by communications and communicators.

Faith in Our Mission

In closing, I would like to get back to Ham radio. Not all Hams are in the electronics business and, perhaps fortunately, not all who are in electronics are Hams. We come from all walks of life, all races, all creeds, all ages, all sexes.

One of my most thrilling SSB contacts of recent date was Mary K80NV, mother of two girls. Her husband bought a shortwave receiver kit about a year ago without any previous electronics interest. He listened in on the Ham bands and learned code. The whole family became interested. Soon wife, husband and two daughters—ages eleven and fifteen—got novice licenses. Now they have four "generals."

As those of us who started in the "build-your-own" era grow older we can't find time to modify and update our old gear. The revolution of SSB has been a godsend.

More and more Old Timers are appearing at the mike—and what a glorious way to keep up lifetime friendships—and how better to avoid the loneliness and boredom of retirement, when finances or health may limit travel!

Possibly you have noticed frequent absences of some of your SSB regulars, particularly the OT's. Worry not, my friends! They are on CW with an electronic key—and if you're not capable of 50 wpm or more, stay away from 'em!

Ham radio has given me what small technical familiarity I possess, and it has been of direct benefit to me in earning a living. But the nontechnical lessons it has taught me mean much more. You can't embrace electronics in any form without an open mind. The very concept of signals through space requires vision and faith. The stimulus to imagination is unbounded.

The constant search for better methods develops intellectual honesty and tolerance. The opportunity for creation and invention is unequalled in any other field. Nowhere are there greater rewards, material and spiritual. But, above all, is the conviction shared by all communicators, that international understanding is the only sure way to real security on this earth. We must find a mass method of world communication and understanding that will equal the effectiveness of Ham radio in providing for contact, discussion and enlightenment at both ends. May I suggest that a Worldwide Citizens Band requiring no technical knowledge might be a giant step in this direction.

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Systems competence i
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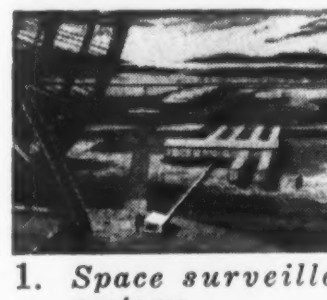
maintenance of:



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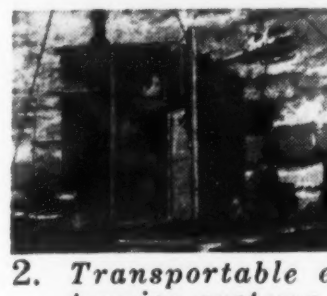
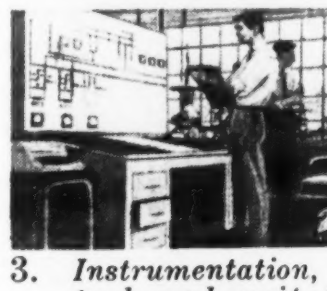


2. *Transportable tronics systems*



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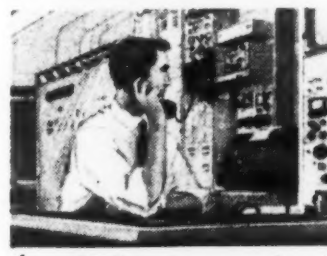

4. *Telecommunicat systems*

5. *Integrated land, and air commu tions systems*

6. *Data systems*

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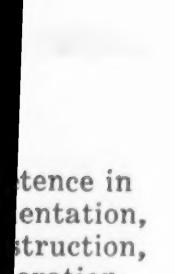

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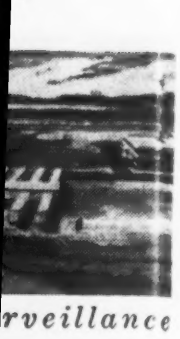

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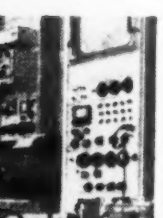

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Management Responsibility

(*Continued from page* 49)

new frontier, one that provides a challenge to all nations, more so than at any other period in history. The only comparable period was the opening up of the new world for exploration and conquest following Christopher Columbus. Now, as in that time, the prestige and power of nations will be determined to a large extent by successes in this new frontier. The fact that we falter and temporize is a serious indictment of our long range foresight and planning ability. We must not allow profits and the enjoyment of the good life to blind us to the impact of the future or dull our zeal to achieve this so-called impossible capability. The fact that we concentrate on small step gains is indicative of our small thinking. I am fully aware that great gains are being made to solve our present day-to-day reliability problems. Many companies are doing this right now. But unfortunately such efforts based on present-day components techniques will never achieve the required results. There is no alternative but to face the fact that our major resources must be applied to research on the molecular structure of the materials used to perform electronic functions to solve this seemingly impossible reliability problem.

I read somewhere else in "the book" an article on the great benefits that accrue from miniaturization that "in addition to these size, weight and efficiency factors, it is important to realize that micro-module construction will improve the reliability of Space Age electronic systems." Here we have it again—the relegation of reliability to a by-product status. This is significant because it represents our thinking, that short-term performance and product design are the things we are striving for, and that "isn't it nice if we can also happen to *improve* reliability at the same time?" Further along in the article the same author writes, ". . . This must continue at an accelerated pace, for our nation's military techniques depend on our ability to stay ahead in electronics." He did not say what or of whom we must stay ahead. I insist again that as far as electronics in the Space Age is concerned, we are not ahead of but seriously behind present requirements. The usefulness of orbiting and space vehicles will be seriously degraded far beyond the point of no-return if we cannot make orders-of-magnitude improvement in reliability of complex communications and guidance systems.

It is very important to realize that the progress between 1955 and 1960 has been achieved by heroic efforts on the part of equipment manufacturers in special selection and test by various, very expensive, programs. Mr. E. J. Nucci of the Office of the Secretary of Defense (Research and Engineering) told a conference at Headquarters, Air Materiel Command, USAF on 18 May 1959 that duplicate testing of component parts by weapons systems contractors has been estimated to cost between $40 to $50 million per year. What is even more significant is that more intensive efforts cannot be expected to yield much better results. It is apparent that several orders-of-magnitude improvement must be made in system reliability, and this would require component part mean-time-between-failure near 10^9 hours. It is in the light of such an impossible requirement that we must define our component reliability goal.

The goal is to place reliability at the top rung of the priority ladder in applying resources to our basic and applied research programs and then to direct these resources toward achieving step-function breakthrough in the use of the molecular structure of matter as it relates to long life performance of the various electronic functions in completely new ways.

The establishment of a goal is no better than the proverbial New Year's resolution unless we immediately turn our attention to the road-blocks in the way of achievement. Let's now look at some of these:

1. Is the Electronics Industry Concerned with the Space Age?

If you agreed with what I said earlier regarding space as the new world frontier, the answer can only be: Yes. Since this will be the first involvement of this fast growing giant with a frontier in which the nation's future position in the world will be determined, this is indeed a momentous conclusion. The revolution in propulsive power development for flight has caught the electronics industry up in its whirlwind, and the two must now be considered as co-equal partners in this technological frontier, even though there may be reluctance on the part of some elements. History shows that pioneering in a new frontier is rarely popular with the masses of people involved therewith. The first recorded pioneering was accomplished by the Israelites under Moses. When life became complicated, they reacted thus, "What have you done to us, in bringing us out of Egypt? Is this not what we said to you in Egypt, 'Let us alone and let us serve the Egyptians'?" The second one of note was the western frontier development out of which grew the United States of America. Here several nations were in competition, but success went to our new nation because we possessed the men of wisdom and foresight, and the technological courage to accomplish their goals. Here again there were many who looked back with longing to the good old days left behind, or grumbled fiercely that the whole thing was not worth the effort, and turned back. The men who had the courage to risk capital and effort grew eminently successful (and rich) and with them rose the fortunes of the nation. I believe the same thing applies in our new frontier in regard to our components reliability situation.

2. Space Not To Be Used by the Military?

The opening sentence of the National Aeronautics and Space Act states, ". . . it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind." None of us disagrees in principle with this admirable policy. However, I believe it is extremely difficult to distingush between military and non-military. In fact, I believe that it is

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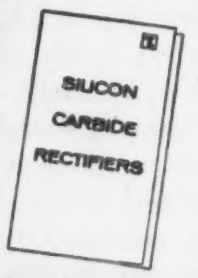
TCS10	100	500	6 @ 100	100	100
TCS5	50	500	4 @ 100	100	50

	SPECIFICATIONS @ 25°C		
Type	Peak Inverse Voltage (volts)	Maximum Inverse Current I_b (μa)	Maximum Forward Voltage @ Specified Current (volts @ mA)
TCS10	100	10	12 @ 100
TCS5	50	10	8 @ 100



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a mistake to insist on a differentation when we are in a "frontier situation" under conditions of "inactive" conflict. Brigadier General Homer A. Boushey, Director, Advanced Technology, Headquarters, USAF, covered this difficult problem in admirable fashion in an address to the American Rocket Society entitled, "Air Force Uses of Space" last 17 November. It is a refreshing and challenging discussion of philosophy regarding "military" and "peaceful" operations. In the technical sense, it is generally true that research and development of military systems requires a much higher degree of excellence and quality in basic components than is commercially available, and that people engaged in this kind of technical work tend to consider in much greater detail the ferocity of the environment in which *equipment* must operate than do those who are engaged in "scientific applications" work. These considerations are directly applicable to the problem of reliability. We must face up to the fact that unreliability of basic components, right now, is the greatest deterrent to extension of techniques into the space frontier. Here we cannot draw very much on history, because of the revolutionary nature of our approach to this frontier, except to note that success in past frontiers was due in large measure to the willingness of key men to accept bold new ideas and techniques wherever they arose, with no argument as to whether or not there were military considerations to worry about in a "peaceful" era.

3. The Philosophical Attitude—"Why Bother?"

This attitude has no place among those who would probe the frontiers. The best example of this attitude was cited by Lieutenant General James D. O'Connell, USA, (Ret.), in "the book"[4] in a story about the great naturalist, Thoreau. Thoreau had a friend who was involved with the linking of Maine with Texas by new telegraph lines and who expressed his pride in this accomplishment to Thoreau. Thoreau completely deflated his friend when he thoughtfully said, "What in heaven's name can the people in Maine have to say to Texans?" This philosophy is very prevalent in our country today. There are those who say, "Why in heaven's name do you want a satellite relay that can operate for three years?" and they express themselves by witholding funds for achieving the basic development which would make this possible. These are the same types of people who said eleven years ago, "Why in heaven's name do you want inertial reference equipment, and complex computers in packages small enough for a flight vehicle?" Getting around these obstacles is a formidable management problem.

4. The Solution is "Make It Simple"

We do not need to spend much time with this road-block, but we do still hear it. This is the age-old yearning to return to the simple problems of the "good old days." This is the expression of those caught up in "frontiering" against their will or inclination. Our present frontier presents technical problems which are not simple, and it is folly to waste time in hoping that the solution can be a simple one.

5. Relations of Materials to Components not Understood

This statement, of course, applies in general, but I am most concerned with this relationship in electronic components because I see no general awareness of the need to understand the molecular structure of the materials used for such components. On the other hand, I know that there exists, at least within the Air Force, a potent program of materials research to speed the availability of reliability in other types of components. Published statements have indicated some of the problems that exist in this regard, chief of which is the matter of who should pay for such basic work. Some spokesmen for the components industry have said that government must pay for the basic research and development program. This indicates that it is felt that the requirement is only a military or defense problem, which is true in a narrow sense. However, in the broad sense, if the electronics industry is to assume its role as co-partner with the propulsion industry in the space frontier, then the problem becomes one of identification with the future strength of our nation, and hence, a problem of solution for the common good. I feel that our economic history proves that the financial rewards to those who have taken up such challenges in the past have always been substantial. These rewards have been so substantial in many cases in the past that they have been cause for alarm on the part of our government. Obviously this discussion is most pertinent to the large companies who are leaders in the industry, because only they possess the resources necessary to adequately attack such an expensive and difficult endeavor.

6. Products vs. Quality

I previously have alluded briefly to the tendency we have, as a nation, to concentrate most of our effort on new applications made possible by a major research breakthrough and live with any quality which happens to evolve. Mr. P. E. Haggerty,[5] President, Texas Instruments Incorporated, said, "The transistor is important, not just because of its own amazing properties and what they mean to electronics, but because it was the big breakthrough the industry needed to make it focus on a new frontier. This new frontier is the very structure of matter itself. . . . The Maser and the parametric amplifier already have resulted, and it is safe to predict these are just the beginning. As our insight into the solid state deepens, we will be able to construct true solid state circuits performing complete electronic functions and obsoleting our concepts of components such as the transistor, diode, resistor, capacitor, or inductor as we hold them today. Solid state circuits promise size reductions of 1000 to 1 from present printed circuit concepts, large reductions from present concepts of miniature module circuits, and almost immeasurable improvement in reliability. . . ." It is highly gratifying to hear this from leaders in the industry. There is no more precious commodity in our nation today than analytical thinking on the part of management, coupled with foresight and planning ability based on a technical foundation of know-how as to what is important. I also have complete faith in the ability of our scientific community to achieve tremendous things if given the resources and the encouragement which they need. I feel that in the past a preponderance of emphasis has been placed on making "things." That these "things" are commercially successful is not a final answer. I believe we have reached a point of decision on this. I don't think that there is much doubt that unreliability has been the main stumbling block in sales of color television receivers. Is this the order of complexity that can be tolerated with the present level of components, even commercially?

Drastic steps must be taken by both government and industry to achieve the reliability goal we have set. A start has been made by the Department of Defense through its Ad Hoc Study Group on Parts Specifications Management for Reliability. The work of this Ad Hoc Group uncovered many problems which government must solve, particularly in regard to specification control of

basic parts quality and to procurement and operational practices. One especially acute problem in regard to procurement practices lies in the resupply of components for field replacement. Many forces have been at work to make competitive pricing the only basis of selection of resupply sources. This, of course, precludes any hope of maintaining a high quality level of these parts—in fact forces a situation in which absolutely inadequate parts are purchased for replacement of field failures. Solutions to these wrong practices must be found to make present equipment useable. This is but one example of the many things which must be corrected simultaneously with immediate action to achieve the goal described herein.

In conclusion, both Industry and Government must:

1. Have the courage to admit that our present component reliability situation is indeed serious.
2. Have the zeal to achieve step-function advances by liberal support and by encouragement of esoteric ideas.
3. Develop a sense of proportion which will avoid the expenditures of billions for system development and next to nothing toward achieving the component reliability which will make the systems worthwhile.

It is significant that the achievement of building components of quality which made the Empire State Building possible was attained by learning the molecular structure of concretes and steels and developing the required strength and durability by careful control of that molecular structure. Our goal is clear: We must achieve this kind of durability and reliability in missile and space vehicle components.

Today the status of our pioneering in space is avidly followed by the nations of the world. Every time we have a missile or rocket failure the details appear the next morning on the front pages of newspapers everywhere. We can say that we learn a great deal from these failures. From an engineering viewpoint this is, of course, true. But we cannot deny that our prestige suffers with each failure. Our goal must be to reach the basic solution to the reliability problem as quickly as possible.

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1. SIGNAL (Journal of the Armed Forces Communications & Electronics Association) March, 1959, p. 6.
2. Ibid p. 6
3. Ibid p. 29
4. Ibid p. 34
5. Ibid p. 6

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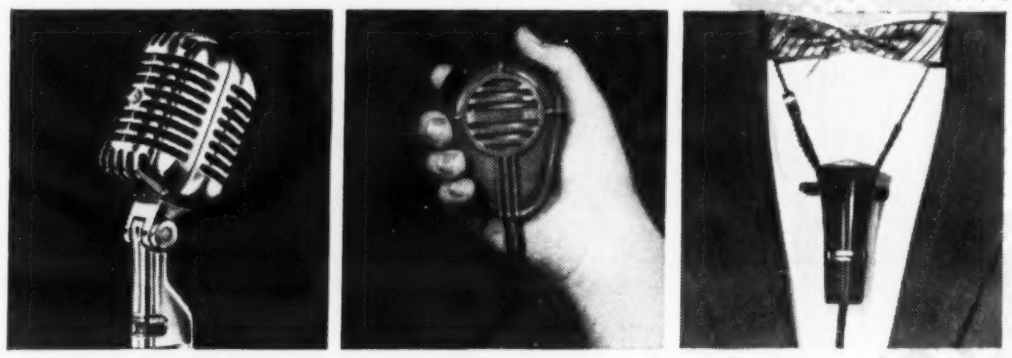

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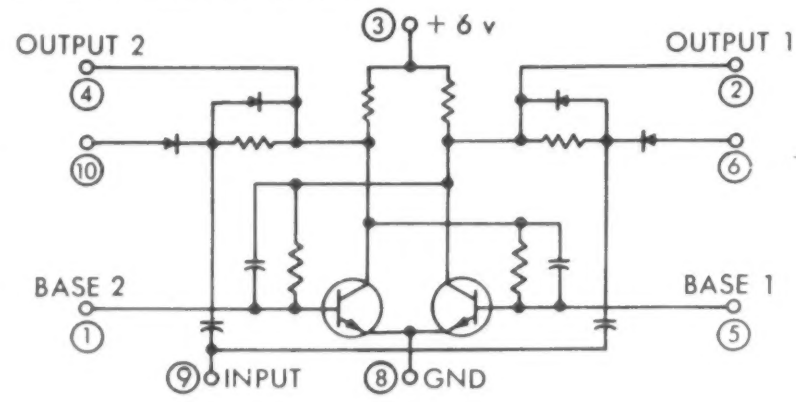

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The following listing gives information about some of the technical papers presented at the Institute of Radio Engineers International Convention, March 21-24, New York City.

SATELLITE COMMUNICATIONS were discussed in two papers. In the paper by W. L. Glomb and W. Teetsel on a radio relay system for low flying satellites, the following points were made: (1) Considerable compression of data before transmission is necessary; (2) The requirement for minimization of satellite size, weight, and complexity determine many features of the ground station design; (3) Simultaneous restrictions on range, antenna bandwidth and transmitter power require the application of low noise amplifiers,threshold optimization and digital/fm transmission. The paper on a multi-station communication network by L. Pollack and D. Campbell, ITT Laboratories, gave advantages and disadvantages of both a passive spherical reflector in a low altitude orbit and an active repeater in a 24-hour orbit. The advantages of the low altitude passive relay are that it involves no electronic equipment and hence can be of simple lightweight construction. In addition, the passive reflector, which has almost unlimited bandwith, can be used at many frequencies and many power levels. The disadvantages are that it requires very high transmitter powers, large antenna sizes and extremely sensitive receivers for a given traffic channel capacity. The active repeater in a 24-hour orbit has the advantage of being within line-of-sight of nearly half the earth's surface at any given time. This makes possible point-to-point communication between widely separated stations. Considerable message capacity can be provided by the satellite relay with powers on the order of milliwatts to a few watts.

"QUICKSILVER" COMMUNICATIONS SYSTEM is a general purpose, long range, high frequency system for air-ground-air use. Recently declassified by the U. S. Air Force, the high data rate system has been under development for the Communications and Navigation Laboratory at the Wright Air Development Center by the Communications Division of Hughes Aircraft Co. "Quick-silver" is well adapted for use where long range, two way, multi-purpose information handling requirements can be foreseen for future system expansion, according to A. C. Chapman, Hughes Aircraft, who presented the paper.

RADIO SIGNALING VIA SOLAR REFLECTION can be accomplished at slow rates with some degree of reliability, according to D. J. Blattner, RCA Laboratories. However, radio relaying by reflection from the sun would require large antennas, powerful transmitters and advanced receivers.

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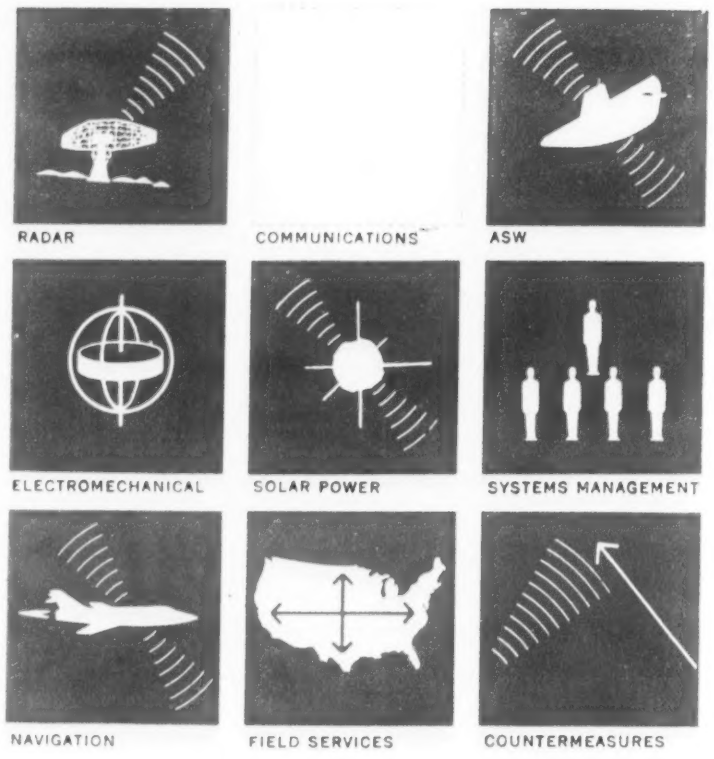

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Military Products Division

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Significant developments at Hoffman have created positions for scientists and engineers of high calibre. Please address inquiries to Vice President, Engineering.

Soldiers run through a smoke filled street in Wernberg, Germany. This picture was taken 15 years ago on April 22, 1945.

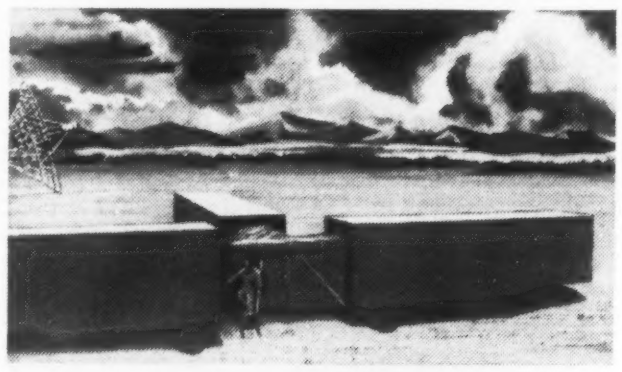
Armed Forces Day

On March 5, 1957, the President of the United States directed by Proclamation that the third Saturday in May of each year be observed as Armed Forces Day. Since that year, the Armed Forces of the United States have given the public an opportunity to observe annually through displays, demonstrations and personnel, the nation's military strength so that all might know how and where we stand as a power for peace with freedom and justice. AFCEA salutes the members of our Armed Forces, many of whom have dedicated their lives to the cause of freedom. As stated in The Prayer for Armed Forces Day, issued by The Armed Forces Chaplains Board, "May we ever be mindful that weapons and munitions do not constitute the true strength of our Armed Forces, but that it comes from men and women who are courageous, loyal, trustworthy, and dedicated to a mission . . . ."

THE BIG A LEADS THE WAY TO *INTEGRATED* COMMUNICATIONS SYSTEMS

SATELLITE RELAY SYSTEM A reliable, worldwide network for television, facsimile, telephony and telegraphy communications will be realized in the near future through PROJECT COURIER of the Advanced Research Projects Agency and U. S. Army Research & Development Laboratories. As subcontractor to I. T. & T., Adler is responsible for engineering and manufacture of the ground stations of this earth-satellite relay. Each of these air-ground transportable stations can duplex transmit, receive and store 15 million bits of information in the 4-minute-contact with the satellite. The COURIER's pre-launching checkout system, also, was produced by Adler.

TRANSPORTABLE TROPOSPHERIC SCATTER SYSTEM
A new concept in continent-spanning tropospheric scatter communications soon will be available to the U. S. Air Force. For the first time, the full multichannel capability and reliability of a large, fixed installation will be provided in a compact, air-ground transportable package. The all-environment, 10KW, AN/MRC-85 is being designed, system integrated and manufactured by Adler under subcontract to Page Communications.



SPECTRUM-STRETCHING COMMUNICATIONS SYSTEM
Through Adler pioneering in heterodyne repeating, a wide range of UHF channels have been opened to the U. S. Army for NIKE Missile field communications. The Adler "F-Head" unit permits the basic AN/TRC-24 VHF system to be used for UHF relaying in areas where VHF spectrum congestion is a problem. Designed for plug-in use, the "F-Head" heterodynes the VHF output of the AN/TRC-24 to the usable UHF range. Adler heterodyne techniques are finding an ever-growing place in military, industrial and commercial communications.

Write for all the facts on how Adler experience can help solve your communications problems.

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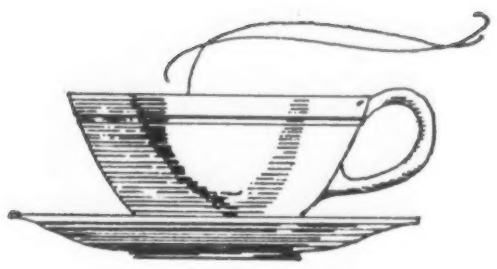
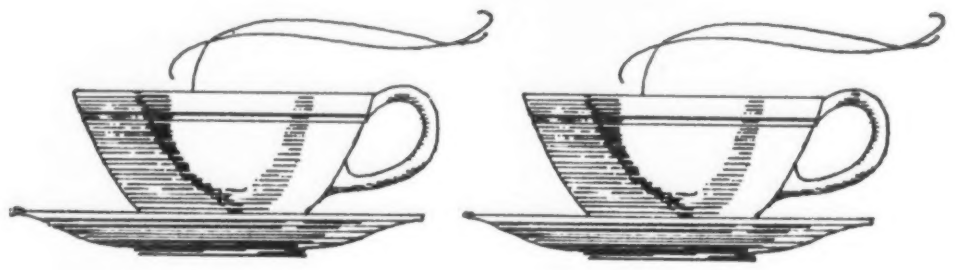
TAKE A COFFEE BREAK 

...TAKE TWO! 

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Designed to receive up-to-the-minute maps and data transmitted over the National Facsimile Network, "Weather-fax" is used by the Air Force, the Navy, the Army Signal Corps, the Weather Bureau and other governmental agencies. In addition, commercial air lines, weather reporting services and the geophysical divisions of major oil companies find it indispensable.

Find out if your company can profitably use facsimile recording. And then investigate "Weather-fax." It's the most advanced machine of its kind—and just one of a complete line of outstanding products made by the world's largest developer and manufacturer of facsimile communications equipment and accessories.

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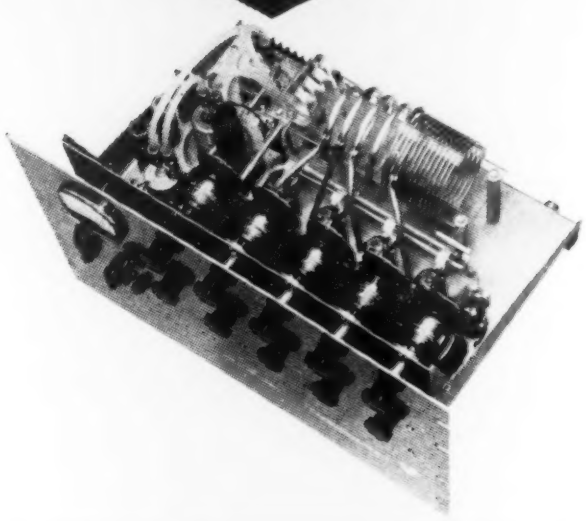

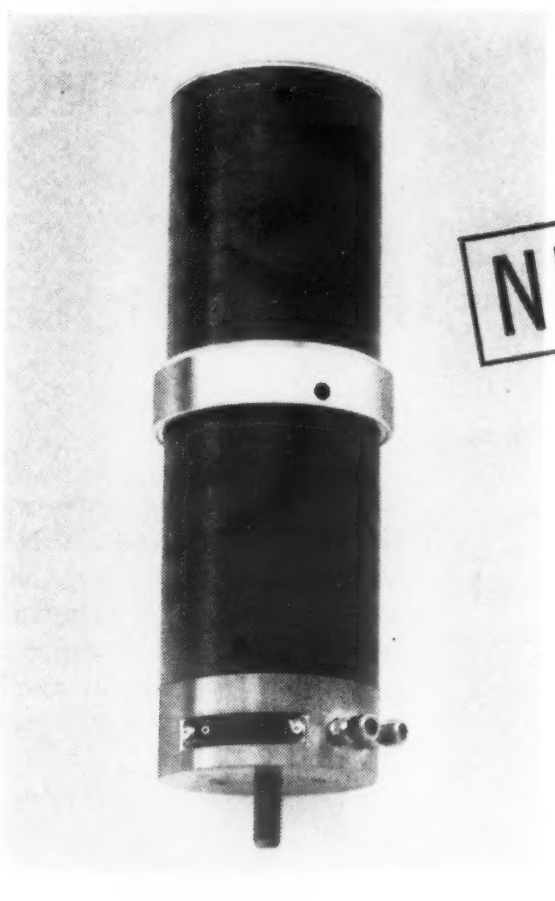

In constant search for more favorable size and weight ratios, the imaginative engineering at Yuba-Dalmotor has developed two new compact linear amplifiers.

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For the first time complete and instantaneous band switching with either local or remote control, from 2 to 30 MC, 2 to 5 bands. Unit is capable of 3000 watts PEP input on SSB, also suitable for AM, CW, FM and FSK. Highly efficient and compact through use of Jennings vacuum components, and 3 water-cooled Eimac high power tetrodes in a grounded grid configuration. High degree of linearity attained through use of screen clamping. Adaptable for amateur or commercial service — for portable, fixed station, or portable-mobile use. Available in cabinet or rack mounting.

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For full details on either of these new compact linear amplifiers contact—

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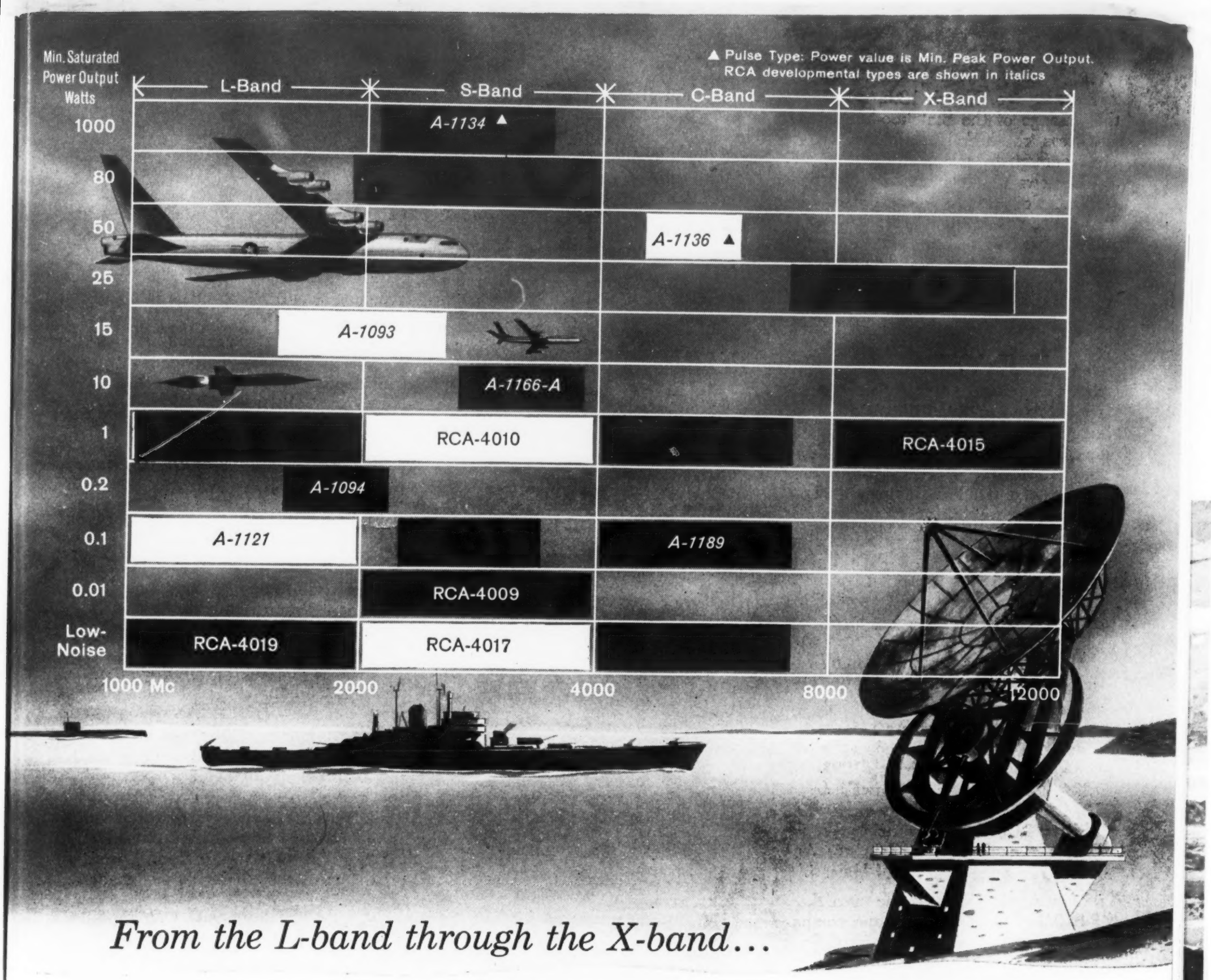

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The chart above shows the wide range of RCA traveling-wave tubes available for your designs. New types and improved versions are constantly being added to the list. Each of them is designed for long life and reliable performance. In fact, *RCA gives you a 1,000-hour warranty on all commercial TWT types.*

Under actual field conditions, it is often possible to obtain unusually long and reliable operation from RCA TWTs. For example,. a recent letter from Jacques Baerlocher Corporation in Zurich reported: "The RCA-6861 installed in the radar equipment at Zurich Airport just failed after 19,200 hours of service. It is interesting to note that the tube kept its good properties until the last hours." Performance records such as this are the result of advanced design plus the painstaking care RCA puts into the manufacture of TWTs.

For complete information on RCA Traveling-Wave Tubes and how you can obtain "customized" types to meet your specific requirements, get in touch with the RCA Field Office nearest you.

RADIO CORPORATION OF AMERICA *Electron Tube Division* *Harrison, N. J.*

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Hawaiian Telephone Company

by J. BALLARD ATHERTON
President
Hawaiian Telephone Company

A YEAR ago, March 12th, news of the passage of the Statehood Bill by Congress reached Hawaii appropriately enough by telephone.

The news was telephoned from the halls of Congress to Iolani Palace in Honolulu, where the Territorial Legislature was in session, via the land lines across the nation and the transpacific cable lying on the floor of the Pacific Ocean.

Passage of the bill stimulated tremendous interest in Hawaii from other states and from foreign countries. Tourists came in increasing numbers and mainland investors and businessmen took a good "second look" at Hawaii. As a result new businesses were started, others expanded and the building boom continued. More business and more people meant more telephones and more calling.

Hawaiian Telephone Company, which has served the people of Hawaii under six different forms of government, looks forward to the challenge of increasing communication requirements in the Islands.

The company was chartered in 1883, when Hawaii was a monarchy. Since then there followed a Provisional Government from 1893 to 1894, the Republic of Hawaii from 1894 to 1900, the Territory of Hawaii. Military Government during World War II years, and finally since August 21, 1959, the State of Hawaii.

Among the top 10 in the more than 3,850 independent telephone companies in the nation, Hawaiian Telephone Co. has been a leader in the telephone industry. In 1910, the installation of an automatic Strowger system in Honolulu made it one of the first major cities in the world to have dial service. Since 1957, Hawaiian Tel's system has been 100 per cent dial operated.

Serving island communities, Hawaiian Tel pioneered the use of radiotelephone systems. In 1931, the company operated a specially built 30-40 megacycle system between the islands, the first of its kind in the world to operate commercially over water at those high frequencies. That same year, Hawaii was connected to the mainland by a transpacific radiotelephone service via a single circuit between Honolulu and San Francisco.

Many changes and improvements have occurred since the day 82 years ago when the first telephone was introduced to the Islands.

Today Hawaiian Tel has the distinction of being the only independent company in the nation to serve an entire state. It also is unique in having natural toll free dialing area boundaries—they stop at the waterline. Toll free dialing service is enjoyed by the company's more than 135,000 subscribers within his own island. An extensive network of toll radiotelephone and radioteletype circuits connect the islands of Hawaii, Maui, Oahu, Kauai, Lanai and Molokai.

A 36 high-quality-voice-channel transpacific cable has been in operation since 1957, connecting Hawaii with other states and points West. The 2,400-mile twin cable was installed between Hawaii and California as a joint undertaking of American Telephone and Telegraph Company and Hawaiian Tel.

During the past year, Hawaiian Tel climaxed a decade of unprecedented growth with a record gain of 14,623 telephones. On January 1, 1950, the company had 89,204 telephones in service and by December 31, 1959, it served 191,373 telephones — an increase of almost 115 per cent.

The islands' population increased by only 27.2 per cent during the same period, indicating that the continued economic growth of Hawaii, rather than the population growth alone. has been a predominant factor in the increase in telephones.

Telephone usage in 1959 also set records. Transpacific calls completed amounted to 433,793, and interisland calls totaled 467,216. The volume of originating calls of all types for each business day exceeded 1,163,000—an increase of about eight per cent over 1958.

The past 10 years also saw total plant investment increase from $23.5 million in 1950 to $76.7 million at the start of this year. This is a gain of 226 per cent.

Some $38.1 million in new capital was raised during the decade to finance the company's growth. The number of common stockholders more than tripled to 10.461, making it the most widely held Island corporation.

Even with these large increases in telephones served and the amount of plant to install and maintain, the work force rose only 31.5 per cent during the decade. The company had 1,687 employees at year's end.

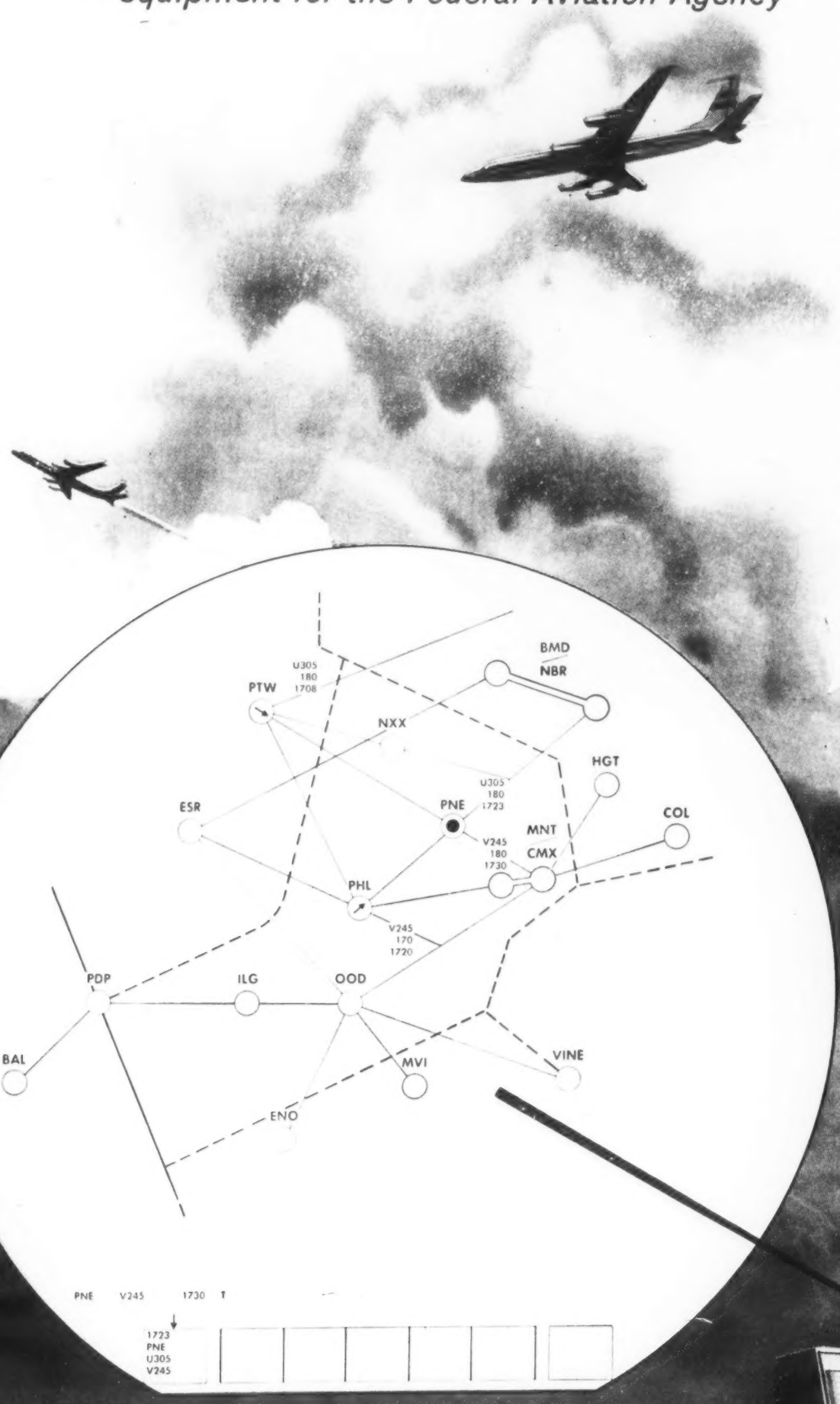
In addition to meeting the needs of the civilian population, Hawaiian Tel is being called upon to provide ever increasing, highly specialized communication equipment and services for national defense.

Hawaii, strategically located midway between the mainland United States and Asia, is one of our country's most vital military outposts. It is the headquarters for the largest U. S. military command in history and is headquarters for the Commander-in-Chief, Pacific. This command includes all U. S. Armed Forces in the vast Pacific area.

Within 10 minutes of the Com-

GPL data handling

equipment for the Federal Aviation Agency



GPL's experience and ingenuity are at work assisting the FAA Bureau of Research and Development in the creation of a modern data processing central, the heart of tomorrow's air traffic control system. The central will receive up to 400 aircraft flight plans hourly, "remember" 1,000 such plans simultaneously and transmit 200 plans and 800 updates hourly to adjacent centers. Automatic processing and unique displays of such data will make significant contributions to the efficient control of aircraft in en-route, transition and terminal areas.

The FAA data processing central is just one of a number of airborne and ground-based programs reflecting GPL's capabilities in the data handling field. These programs are supported by GPL's proven ability to understand the customer's problem and capacity to anticipate future requirements. The GPL organization is "systems oriented," offers complete capabilities ranging from research, engineering and manufacturing to customer service.

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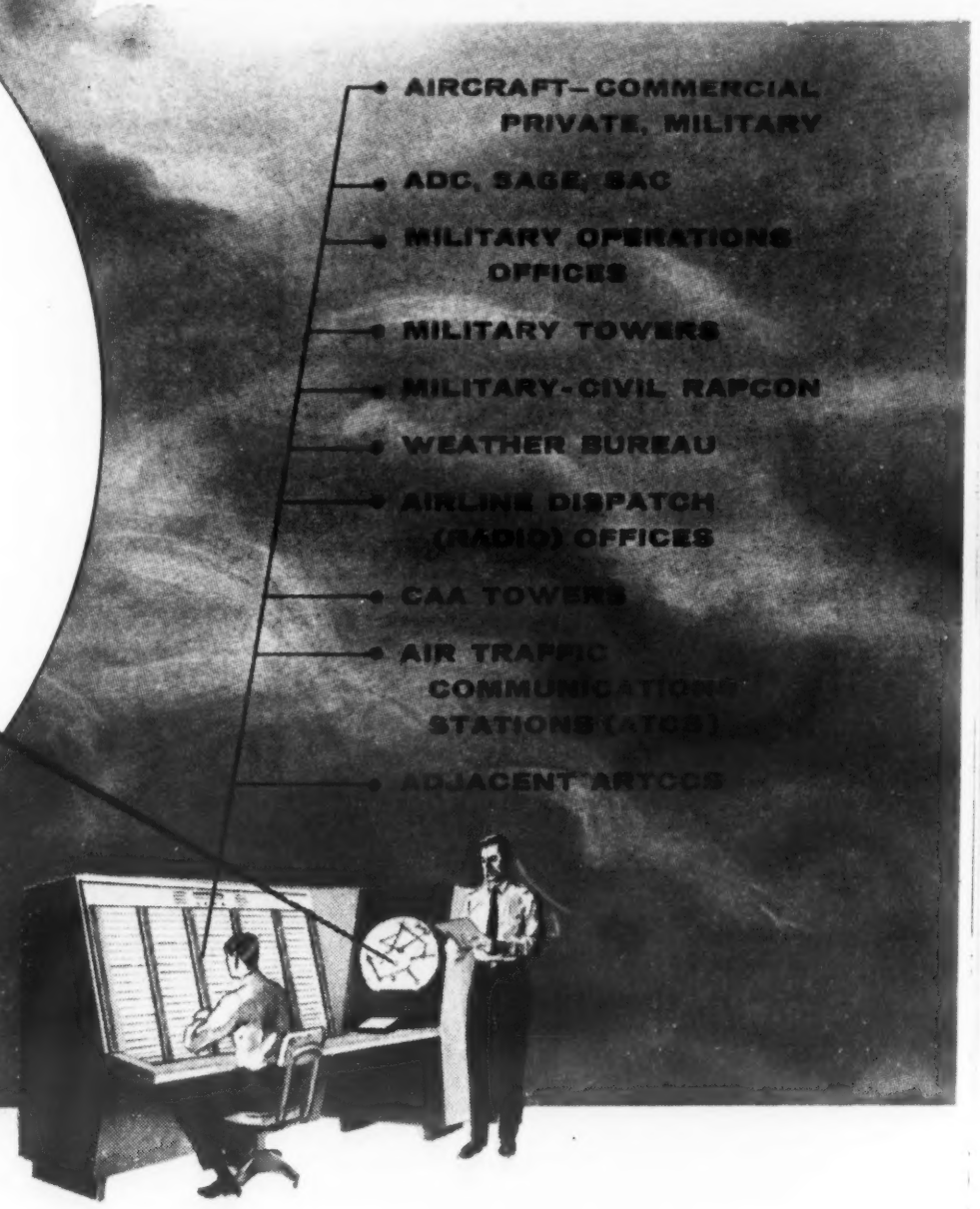

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mander-in-Chief's Oahu headquarters are the command posts of the Pacific Air Forces, Pacific Army, Pacific Fleet and Pacific Fleet Marine Force.

Defense installations in the islands include Pearl Harbor, Fort Shafter, Hickam Air Force Base, Fort Ruger, Schofield Barracks, Barber's Point, Kaneohe Marine Corps Air Station, Fort Armstrong, Camp H. M. Smith, Wheeler Field and Bellows Field.

All of these installations are served by government owned and operated dial offices and are interconnected by an extensive network of government owned cables. Calls to and from these military installations and the civilian population throughout the islands and to other states are routed over connecting facilities between the military system and Hawaiian Tel's system.

With the coming of the Space Age, Hawaiian Tel also is playing an increasing role in fulfilling the island communication requirements for the Air Force Ballistic Missile Division, the Air Research Development Command, the National Aeronautical Space Authority, the Pacific Missile Range, Strategic Air Command and the Office of Defense Mobilization.

The missile tracking stations at Kaena Point, Oahu; South Point, Hawaii, and Bonham Air Base, Kauai, are served by the leased facilities of Hawaiian Tel. Such facilities include cables handling both voice and highspeed teletypewriters which connect the stations with other key stations throughout the world.

In addition, Hawaiian Tel leases facilities to the Hawaii Air National Guard for the Nike-Zeus project and the long-range radar network protecting the islands and the nation.

Hawaiian Tel also provides the facilities for the Federal Aviation Agency's new communications center at Diamond Head. The center controls the air route traffic by instant, direct connection with both military and commercial control points.

The cooperation between Hawaiian Tel and the Armed Forces in general has been excellent as demonstrated by the manner in which arrangements have been made for the use of interconnecting and other plant facilities.

Plans are now under study for developing a universal numbering plan applicable both to the military and Hawaiian Tel communication networks. Study also is being made to extend direct inward subscriber dialing from Hawaiian Tel's system to locals within the military systems.

From time to time our plant training school makes classes available to the Armed Forces personnel.

Equipment and services for Civilian Defense also are provided by Hawaiian Tel. In addition, the company encourages its employees to assume key positions in the State CD organization.

With the increased use and demand for our transpacific cable and radiotelephone facilities, Hawaiian Tel this summer will begin work on increasing the cable circuits by 12 to total 48 channels.

Work on TASI meanwhile is expected to start next February. TASI, or Time Assignment Speech Interpolation, is an electronic device which will lace the gaps and pauses in telephone talk to enable the transpacific cable to almost double its present number of circuits.

With the growth of communication requirements in the Pacific area, preliminary plans are being considered for a second cable to the mainland and a cable to Japan within four to five years.

The impetus given to Hawaii's economy by Statehood and the continuation of the present high level of military activity mean Hawaiian Tel faces a growing demand for communication facilities. We look forward to this challenge.

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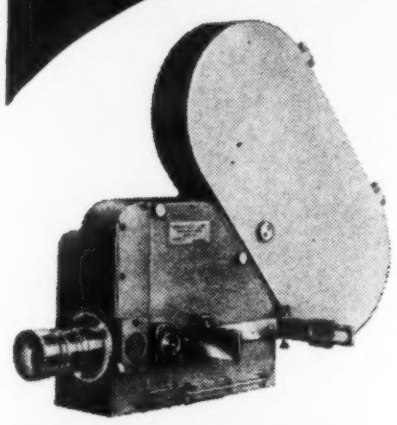

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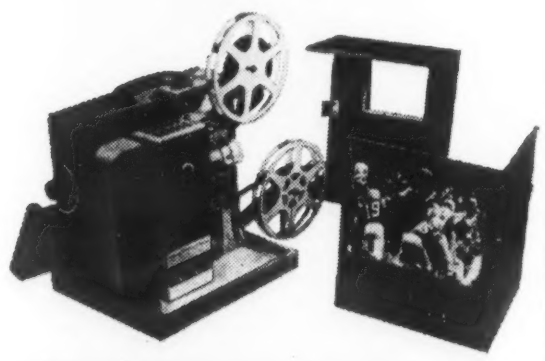

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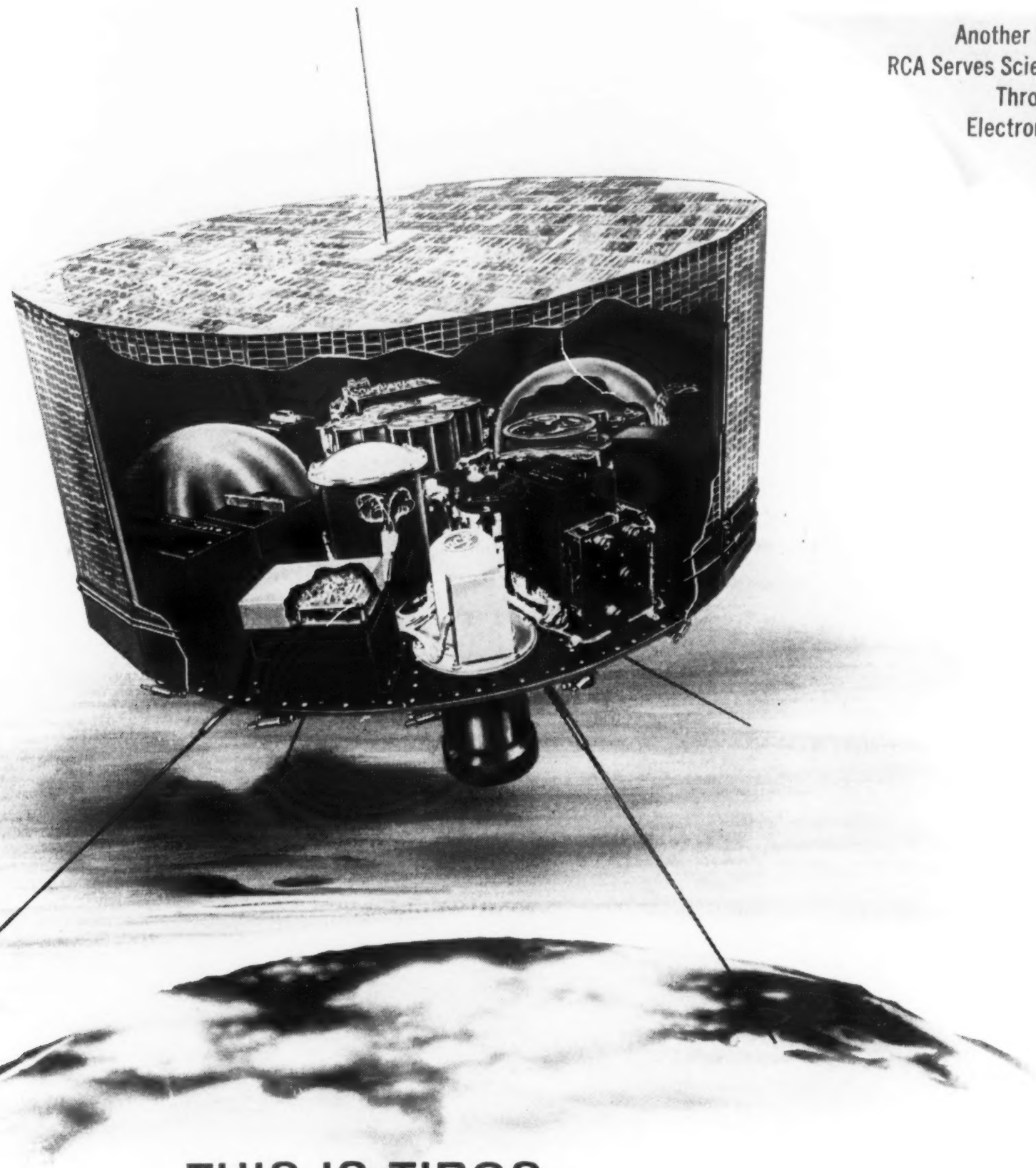

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Experimental Weather Observer

This is TIROS—the world's most advanced television-equipped earth satellite. In one giant step it has extended man's powers of continued observation 400 miles into space. The pictures of cloud cover and wind patterns it is now sending down are a major contribution to the science of meteorology—bringing ever closer the day of improved, long-range weather analysis and forecasting.

The entire TIROS satellite, its component systems and associated ground equipments were developed and built by RCA's Astro-Electronic Products Division for the National Aeronautic and Space Administration under the technical direction of the U. S. Army Signal Research and Development Laboratory. Included in the satellite are two TV cameras equipped with shutters so they can take still pictures, tape recorders to store the pictures when out of ground station range, TV transmitters, command receivers and timing clocks for function control, radio beacons and telemetry equipment, and numerous auxiliary devices to control satellite dynamics. Power is supplied by storage batteries recharged by an array of 9200 solar cells which convert the sun's energy into electricity.

Significant as it is, TIROS is a beginning, not an end. Future satellites and space probes will be far more complex. Yet they will grow out of the experience and capabilities in space electronics, satelliite dynamics and structural loading techniques that made Project TIROS a reality. To find out how you can draw on this unique research and development capability, get in touch with the Marketing Manager, RCA Astro-Electronic Products Division, Princeton, N. J.

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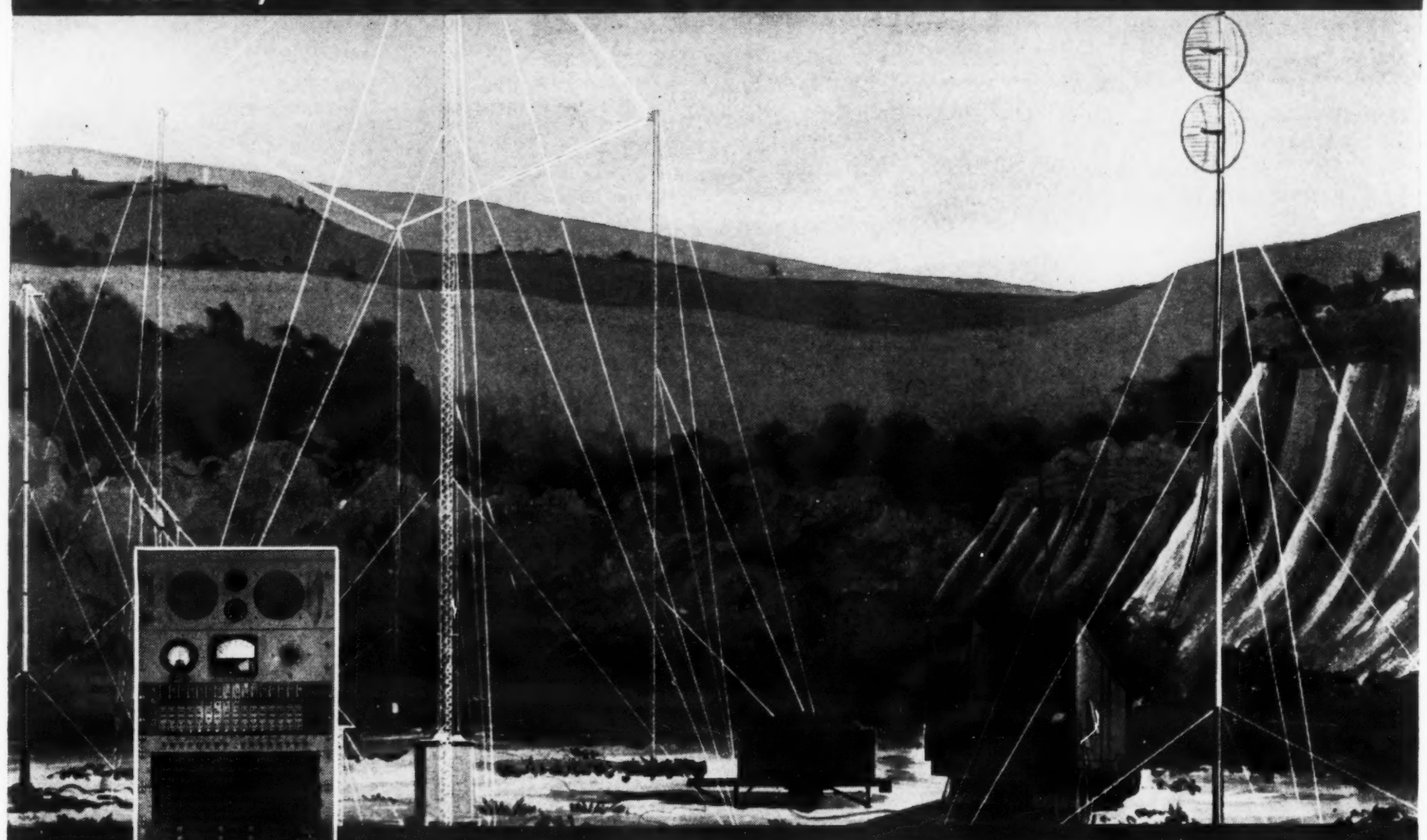

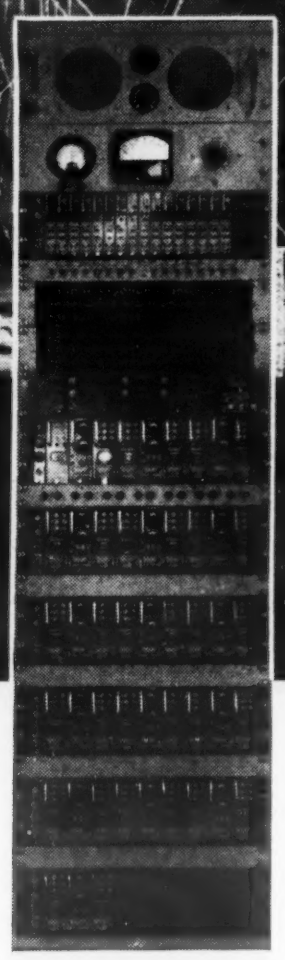

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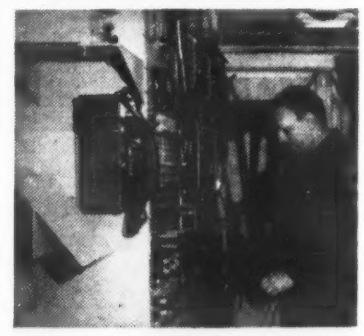

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INDUSTRIAL FORCES IN SCIENCE

by SAMUEL LENHER
Vice President and Director, E. I. du Pont de Nemours & Company

PART I

IN THIS PAPER, what I should like to demonstrate primarily is the essential partnership of science and industry in advancing human welfare. This, to me, is the basic fact of their relationship. Since each supports and stimulates the achievements of the other, we are witnessing an accelerating march of progress throughout the world and strikingly in the United States. Nearly every scientific discovery is translated by industry into technology and products valuable to mankind. Nearly every advance in technology suggests to science a further trail to be explored. We are living at the beginning of an era where science and industry are rushing forward hand in hand, each aiding and activating further advance in knowledge and understanding. We are just now learning to use methods and programs in pure science and in industry which are accelerating the accumulation of knowledge and its application almost beyond our ability to assimilate. This partnership has created social problems which are as yet little understood but on balance the benefits of science to society have far outweighed the disadvantages.

For mutual understanding, let us start with some definitions. Science is accumulated knowledge systematized and formulated with reference to general truths or to the operation of general laws in our environment. Industry is a cooperative effort to fill human needs. Industry as we know it today developed gradually over the ages as people found that by pooling their talents, skills, labor and resources they could accomplish more for themselves and their fellowmen than was possible through individual effort alone. This is also true in science, where no single mind can be expected to encompass more than a part of all the knowledge in one field.

No doubt it could be argued that the partnership of science and industry has existed in some degree since the beginning of man. Primitive man's observation of the orderly and regular procession of heavenly bodies and especially the moon was scientific discovery—though it was mingled with mysticism and religious beliefs. When man related the timing of celestial changes to the seasons and when he used these observations in planning the planting of his food crops and the care of his domestic animals and in his travel by water, we have an early partnership of primitive science and industry.

But, early as man's scientific observations started in our history, scientific inquiry moved slowly until very recently. Man, for thousands of years a migratory hunter and gatherer of food, slowly built a tribal culture which developed in the last 3000 years into our civilization of today.

It was well into the nineteenth century, little more than 100 years ago, before the search for scientific knowledge in planned and organized programs was undertaken. Up to that time, our vast fund of scientific observation and theory had been built up through the inspiration of individuals, who included monks, philosophers, college dons, dilettantes and dedicated artisans and craftsmen. Great discoveries were made during this era but even the impact of the Industrial Revolution brought with it no immediate changes in the method by which scientific knowledge was acquired.

German and Austrian universities became the first centers of organized investigation in many fields of science in the last half of the nineteenth century when professors built up schools and institutes around their creative interests. This academic drive for scientific knowledge spread rapidly through Europe. It is significant to note that brilliant discoveries in chemistry and physics in Germany were promptly followed by industrial development and commercialization based on the new technologies.

In the United States, academic and industrial research were slower in getting under way. Our forefathers were too busy fighting Indians, clearing the wilderness, pushing back the frontier and winning their battle for survival. They had little time for scholarly contemplation, although there were individuals, as Benjamin Franklin, who made notable discoveries. It was not until 1861, however, that Yale became the first American university to award a doctorate in science based on two years of graduate study. The need for scientific study also was recognized in Wisconsin, for an 1858 report of a State Senate committee stated:

"Our religious colleges are practically aristocratic institutions. We are done with the conservatism of the past. . . . It is not by pouring (sic) over the dreamy and mystical pages of classical lore that the student is . . . to enter manfully into the great battle of life—to storm nature in her fortress, and to unlock her treasures; but by obtaining a thorough knowledge of physical science . . . Give, then, to the whole people of the state an educational institution suited to their wants. . . ."

By and large, the United States depended upon Europe for most of its basic research and much of its applied research until 1914. It is true that scientific discovery and technical development in the field of electricity led to rapid expansion here in the generation and distribution of electricity and to scientific research in this field. Also, at the beginning of this century, the rise of large industries presented need for more specialized knowledge to fill the gaps and scientific organizations were slowly built up within industry to support, improve and in every way to expand that industry and its technology.

Advertisement

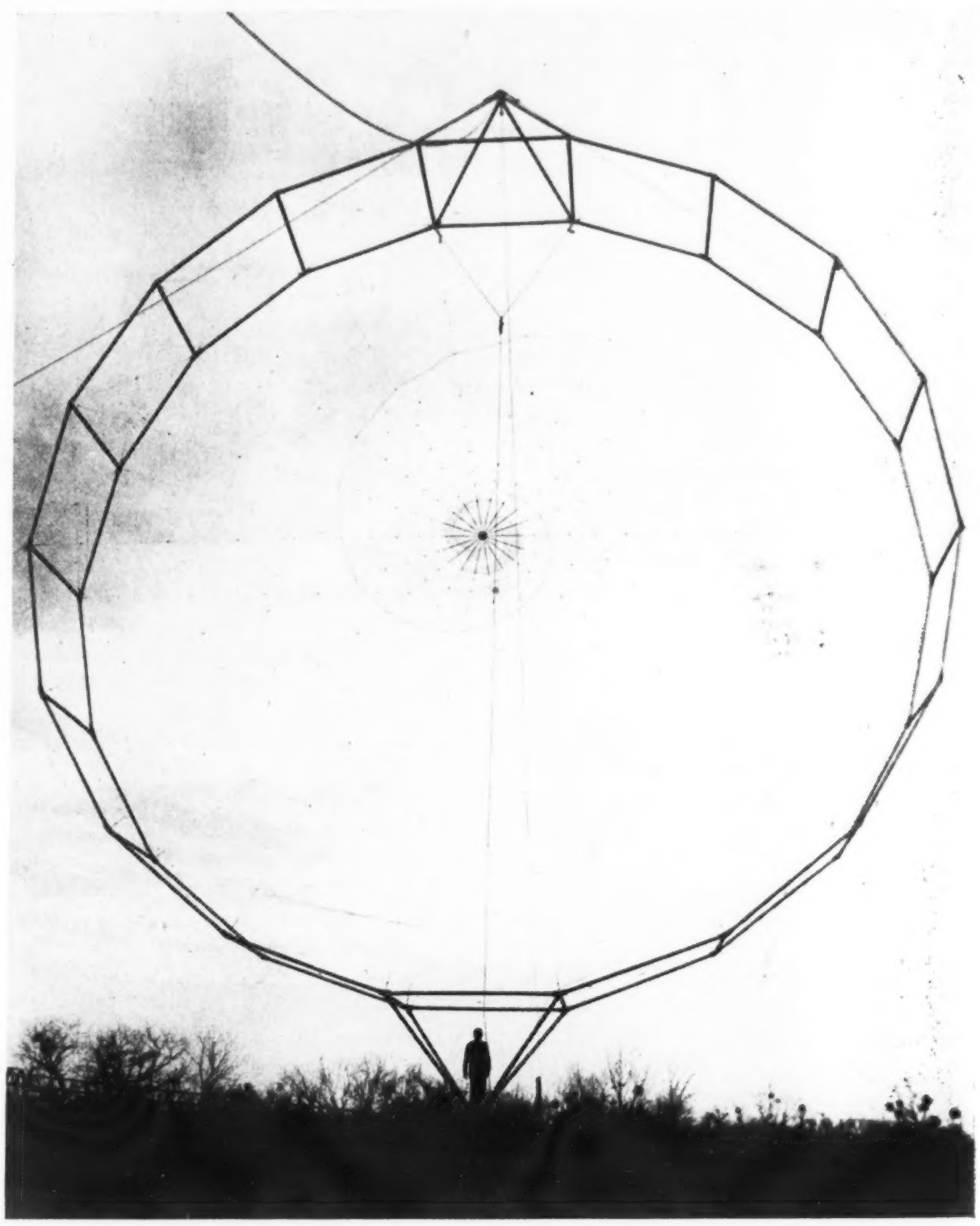
NAVY EXHIBITS SPIRAL ANTENNA

Washington, D. C., May 24, 1960

Today the Navy exhibited for the first time where large groups of military officials could see it, a new type of High Frequency antenna, the Equiangular Spiral in actual operation. This antenna offers a promising new approach to greatly reducing fading and increasing the reliability of communication in the 5-30 MC/S range. Erected and operated by the U.S. Navy in a garden off the east wing of the Sheraton Park Hotel for the benefit of visitors of the AFCEA Convention, the antenna was beamed south to Puerto Rico. This new antenna, developed by the Communication Products Division of APC in Mineral Wells, Texas is a unique adaptation of an antenna type discovered over six years ago at Wright Air Development Center and the University of Illinois. Because of its shape and other restrictions, it was originally conceived for use as a flush mounted air-borne antenna in the VHF and UHF ranges.

Research work at APC developed that the Spiral arms could be adequately approximated and supported by a wire outline composed of not more than two or three wires on each arm. This advancement opened up the practicability of building a Spiral antenna for use in the high frequency range. At about the same time, APC was conducting propagation tests in the high frequency range which indicated that the majority of fading is due to sudden shifts in polarization of the arriving wave, regardless of the polarization of transmitted signal. The engineers working on this project pointed out the desirability of utilizing a circularly polarized antenna rather than a linearly polarized antenna for receiving. The Spiral antenna, being circularly polarized, was a natural choice. A contract was secured with the Navy to construct a Full-Scale version of the Spiral to determine what actual improvement might be realized with a circularly polarized antenna.

Tests were conducted in which the Spiral was evaluated against such antennas as an Optimized Rhombic, three element Yagi, and a Vertical Monopole. Statistics indicated an over all reduction in fading of about 36% as compared to any linearly polarized antenna tested. On long-haul paths, during the transition period near the MUF, the Spiral often reduced fading



as much as 400%. These improvements are in excess of those realized with the average space diversity system employing Rhombic Antennas, etc. It was also found that, although the realized gain of the Spiral was less than that of the Rhombic when good propagation conditions were prevalent, the Spiral consistently showed a gain advantage of from 10 to 20 DB over the Rhombic during transition periods when the ionosphere was unstable and when rapid fading was very pronounced. It could represent a considerable boon to High Frequency communications, where space is a premium, since the Spiral offers a space saving of up to 40 to 1 compared to standard Rhombics.

APC is a research, design and production firm that has specialized in antennas, rotators and hardware of steel and aluminum with special emphasis on light weight. The Spiral Antenna, although 96′ high and 70′ in circumference weighs only 900 lbs. and was erected in only four hours. APC includes practically every type of antenna and tower in its line, particularly for military use.

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Still, it can be said that until the outbreak of the First World War, industrial forces in science were largely European. Wartime interruption of communications and supplies, especially of chemicals and precision instruments, stimulated an intensive rise in scientific and technical work in the United States. Under the pressure of wartime necessity and scarcity, support of science was literally forced on universities and on industry here and in all industrialized countries.

As the universities responded to the need and supplied scientifically trained men and women in growing numbers, these graduates added to the forward drive of science both within the universities and within industry. While the first industrial applications of science were elementary and imitative of laboratory findings, as industry grew and became staffed with scientifically trained men, the depth and scope of scientific work in industry increased and technology became inventive, original and productive.

The Second World War accentuated the development of research in industry and the universities and the so-called "cold war" especially has been responsible for rapid expansion of research conducted for the government. Previously the government had carried on some research in such fields as public health, agriculture and standards for measurement. Today there is even more emphasis upon applied research for defense against military aggression. This suggests that the main objective of government research is the protection of the people, although I hasten to add that scientific development useful for wartime purposes frequently is translated into peacetime accomplishments. The jet transport, which recently has made its appearance in commercial aviation, for example, undoubtedly was hastened because of the need to develop faster fighters and bombers for the Armed Services. The reverse is equally true, for many peacetime products, such as nylon and high octane gasoline, demonstrated their usefulness in war.

Since the role of government research has been primarily protection for the people, the government's activities in this field might be sharply curtailed if we ever have a world at peace. The role of the university, on the other hand, is to seek and impart knowledge. As a reservoir of science and culture, the university trains the industrial scientists and educators of the future. A university is a fountainhead of science, where its professors and scholars engage in basic or

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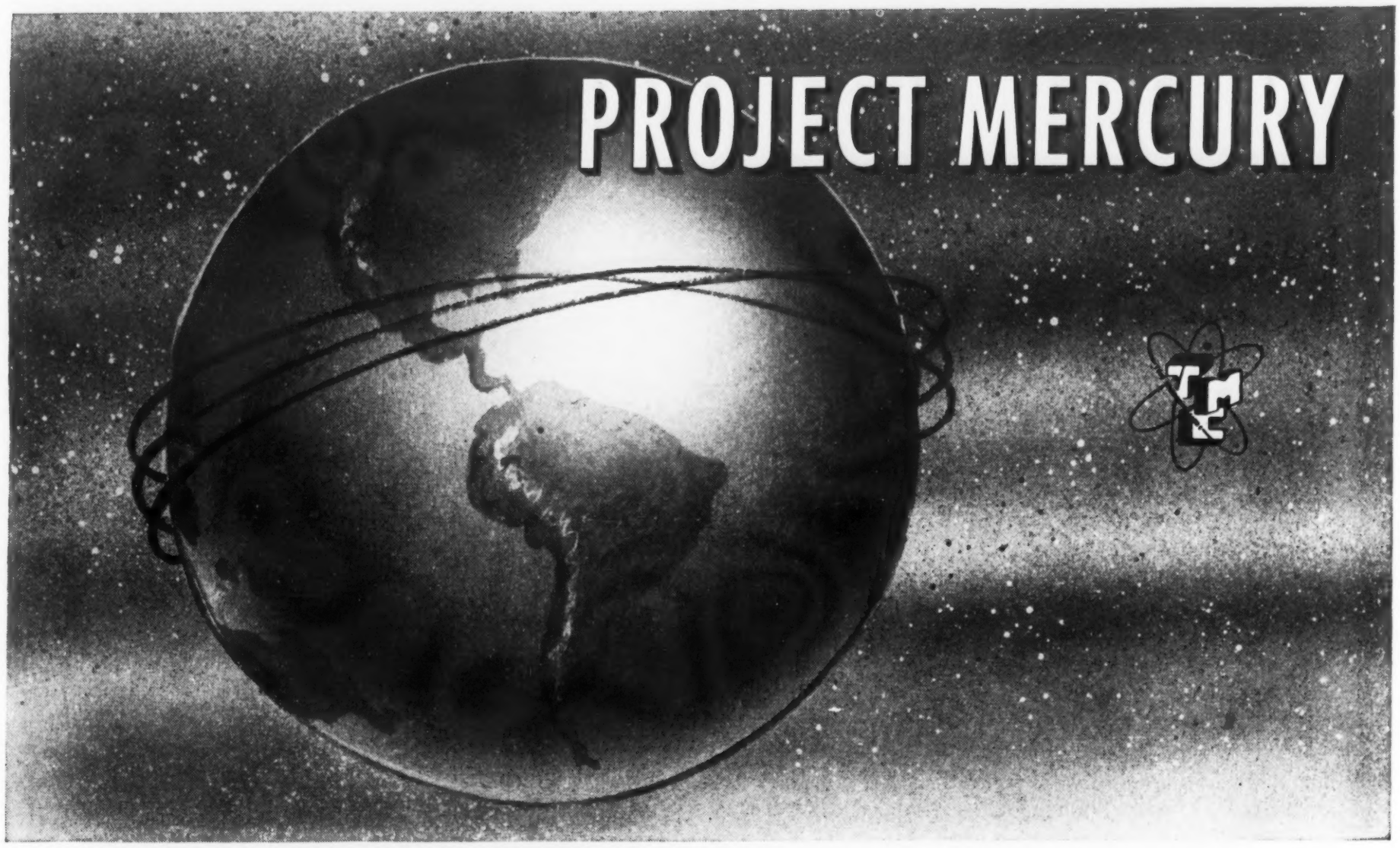
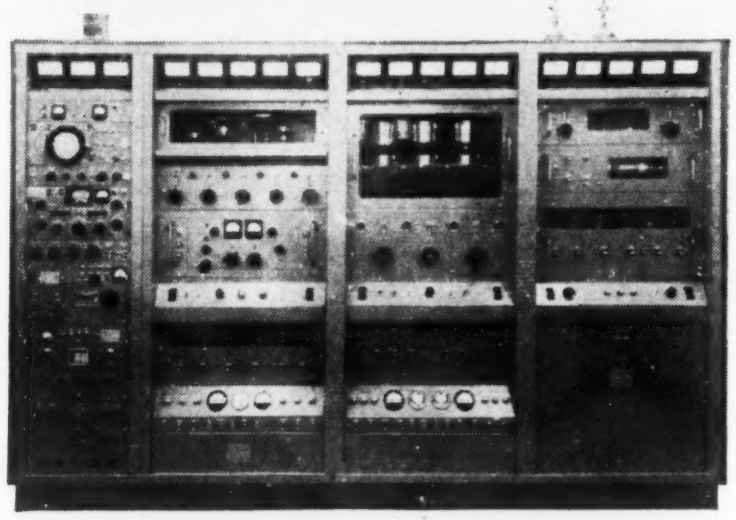
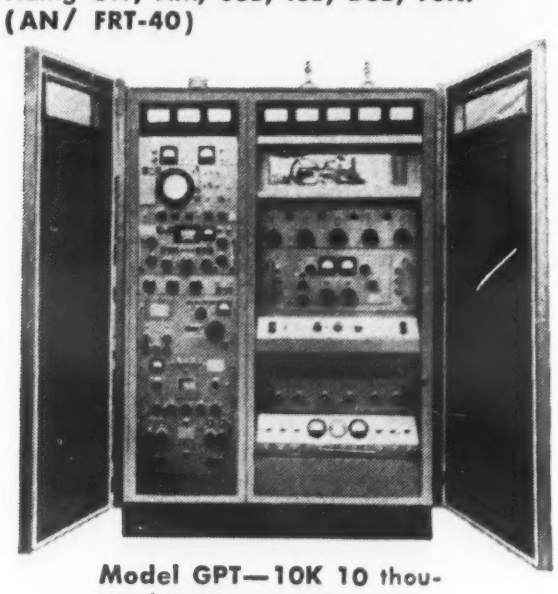




Model GPT—40K 40 thousand watt general purpose transmitter 4 to 28 megacycles providing CW, AM, SSB, ISB, DSB, FSK. (AN/ FRT-40)



Model GPT—10K 10 thousand watt general purpose transmitter 4 to 28 megacycles providing CW, AM, SSB, ISB, DSB, FSK. (AN/ FRT-39)

We are proud to announce that the Technical Materiel Corporation has been selected to participate under a contract with Western Electric Company, Inc., in this national project.

Project Mercury, the name given to this pioneering effort, is directed by the National Aeronautics and Space Administration. One of seven astronauts will be rocketed into space sometime in 1961. This man will be orbited around the earth in a special designed capsule. His flight around the earth will be monitored and tracked by a 16-station communications and telemetry system.

It is with great pleasure and pride that TMC announces we have been chosen by Western Electric Company to supply point-to-point single sideband communication equipment and systems for some of the stations located around the earth. TMC's transmitters and receivers will be used to handle the various messages collected by the tracking and telemetering equipment.

Illustrated here are some of the units TMC is currently producing for the Mercury project as well as other communications systems. We have supplied many complete SSB, DSB, ISB, AM, CW, and FSK communication equipment systems to commercial and military users throughout the world. A complete short form catalogue, describing well over 100 items of specialized communications equipment, is available on request.

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, NEW YORK

exploratory research seeking all kinds of new knowledge to add to man's information. It is estimated that more than half of all the basic research in the United States is carried on in college and university laboratories. The academic institutions also do considerable applied research under contract to government and industry but their primary mission is the development of science itself and the training of future citizens.

The role of industry in its partnership with science is practical and creative. The discovery of a new theory or a new substance in the laboratory may have profound scientific significance but it is of little benefit to mankind unless it can be made to serve a useful purpose. Here industry steps in, with applied research and development, engineering, a great deal of patience and the expenditure of large sums of money without guarantee of recovery or reward. The objective is to find something useful to mankind that can be produced commercially.

Businessmen are sometimes criticized for the emphasis they give to profit and for their reluctance to concede they are in business for any reason but profit. Until recently, at least, industrial leaders have been unable or unwilling to rationalize their role in society as essential contributors to welfare and progress. This reluctance has allowed the critics of our free enterprise system to foster a widespread misunderstanding of the function of profit as an incentive.

Actually, except for ideological argument, whether the objective of industry is profit or human welfare is quite as unimportant as whether the chicken or the egg came first. To earn a profit, it is imperative for industry to provide a product or service which people desire at a price they are willing to pay. Without profit, it is impossible for any component of industry to survive whether it be the one-man store or the largest corporation. Profit and human welfare in our economy are as inseparable as freedom itself.

Put just a little differently, no company can stay in business unless it can pay salaries high enough to satisfy competent management and supervision and provide wages and working conditions sufficiently atttractive to satisfy employees. This is just common sense but it is only part of the story. In addition to management and employees, a company must have money for plants, machinery and working capital. The money is provided by investors who risk the loss of their savings in the hope of reward through dividends and capital gains. If the company doesn't earn a profit, it will be unable to pay dividends and there will be a loss instead of an enhancement of capital. Obviously, the investors then try to withdraw their savings and the company goes out of business.

Since the beginning of the century, industry has increasingly turned to science in its search for ways to operate at a profit. To produce more, to produce better, to produce at lower cost, have been and are still industry's objectives. We hear a great deal about the tremendous improvement in productivity of industry and agriculture. What is important to keep in mind is that the increase in productivity of which we are so justly proud did not come about because people began working harder but because industry made use of science to develop energy, machines, products and processes which enable fewer people to produce more and better things with less physical labor.

The yield from this partnership of science and industry is an economy of unprecedented abundance, instead of scarcity. We need look no further than at our supply of food, a basic necessity of life. Agriculture, transformed by the tractor, chemical fertilizers, weed killers, hybrid seeds, feed supplements and other scientific developments, is now so bountiful our problem is one of surpluses rather than any threat of scarcity or famine. Our surpluses of corn, cotton and wheat cost the taxpayer one billion dollars a year for interest, storage and transportation alone.

We use energy amounting to more than six horsepower per employee today compared to two horsepower in 1900 and the national per capita income, which includes every man, woman and child, has risen from about $200 to more than $2000 in this period. Plant investment per employee has risen from about $2000 to nearly $15,000 and this is reflected by a rise in output, measured by value added in manufacturing, from less than $2000 annually per worker to more than $10,000. Total wealth in the United States has risen from slightly more than $1000 per capita in 1900 to more than $8000 today.

While we have extremes of poverty and wealth, there is no group in our society which has not shared in the benefits of abundance. It was common until after the turn of our century for the breadwinner of the average family to work from dawn to dusk, six days a week, to earn enough

(*Continued on page 92*)

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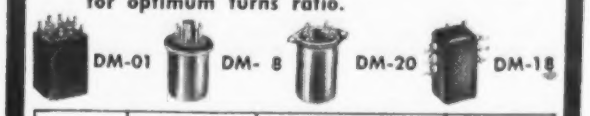

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MPT- 1	TF4RX35YY	0.25/0.25/0.25	250
MPT- 2	TF4RX35YY	0.25/0.25	250
MPT- 3	TF4RX35YY	0.5/0.5/0.5	250
MPT- 4	TF4RX35YY	0.5/0.5	250
MPT- 5	TF4RX35YY	0.5/0.5/0.5	500
MPT- 6	TF4RX35YY	0.5/0.5	500
MPT- 7	TF4RX35YY	0.7/0.7/0.7	200
MPT- 8	TF4RX35YY	0.7/0.7	200
MPT- 9	TF4RX35YY	1.0/1.0/1.0	200
MPT-10	TF4RX35YY	1.0/1.0	200
MPT-11	TF4RX35YY	1.0/1.0/1.0	500
MPT-12	TF4RX35YY	0.15/0.15/0.3/0.3	700

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MGP 2	Plate & Fil.	90027	TF4RX03JB002
MGP 3	Plate & Fil.	90028	TF4RX03KB006
MGP 4	Plate & Fil.	90029	TF4RX03LB003
MGP 5	Plate & Fil.	90030	TF4RX03MB004
MGP 6	Plate	90031	TF4RX02KB001
MGP 7	Plate	90032	TF4RX02LB002
MGP 8	Plate	90036	TF4RX02NB003
MGF 1	Filament	90016	TF4RX01EB002
MGF 2	Filament	90017	TF4RX01GB003
MGF 3	Filament	90018	TF4RX01FB004
MGF 4	Filament	90019	TF4RX01HB005
MGF 5	Filament	90020	TF4RX01FB006
MGF 6	Filament	90021	TF4RX01GB007
MGF 7	Filament	90022	TF4RX01JB008
MGF 8	Filament	90023	TF4RX01KB009
MGF 9	Filament	90024	TF4RX01JB012
MGF 10	Filament	90025	TF4RX01KB013

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MGA 2	Pri. 600 Split Sec. 4, 8, 16	Matching	90001	TF4RX16AJ002
MGA 3	Pri. 600 Split Sec. 135,000 C.T.	Input	90002	TF4RX10AJ001
MGA 4	Pri. 600 Split Sec. 600 Split	Matching	90003	TF4RX16AJ001
MGA 5	Pri. 7,600 Tap @ 4,800 Sec. 600 Split	Output	90004	TF4RX13AJ001
MGA 6	Pri. 7,600 Tap @ 4,800 Sec. 4, 8, 16	Output	90005	TF4RX13AJ002
MGA 7	Pri. 15,000 C.T. Sec. 600 Split	Output	90006	TF4RX13AJ003
MGA 8	Pri. 24,000 C.T. Sec. 600 Split	Output	90007	TF4RX13AJ004
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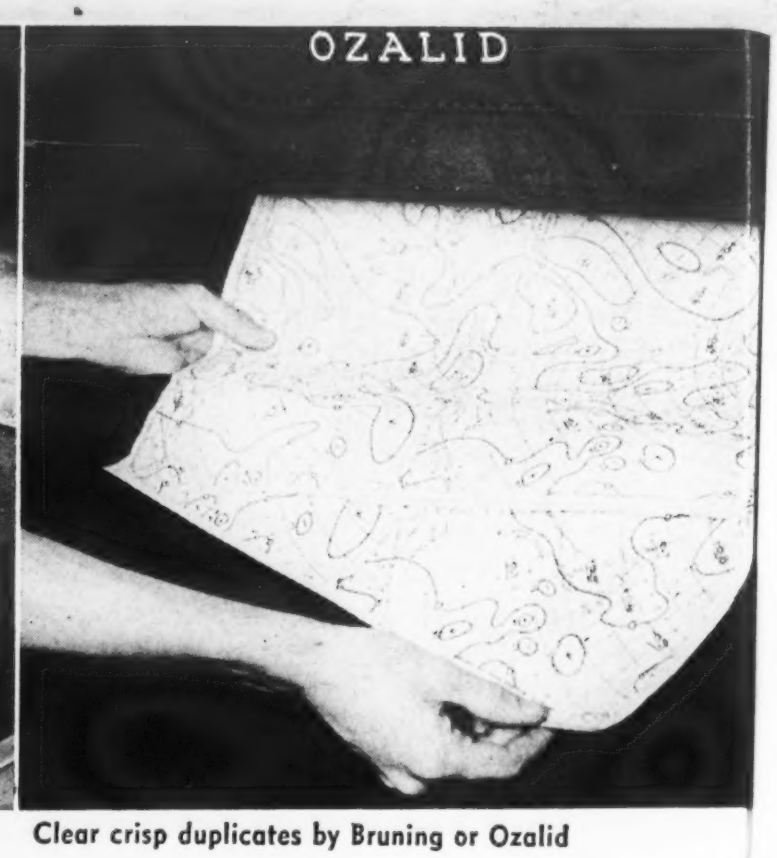

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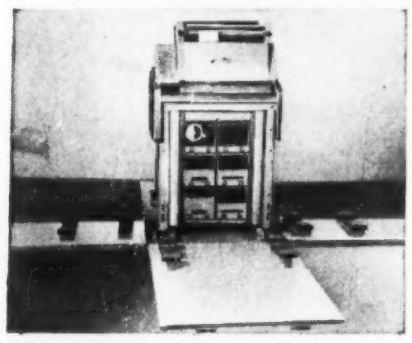

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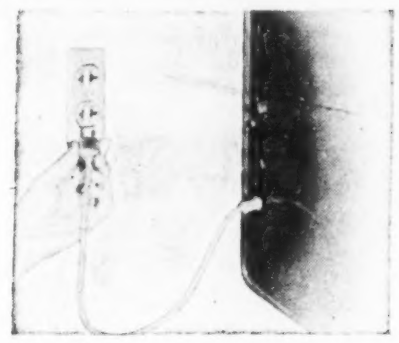

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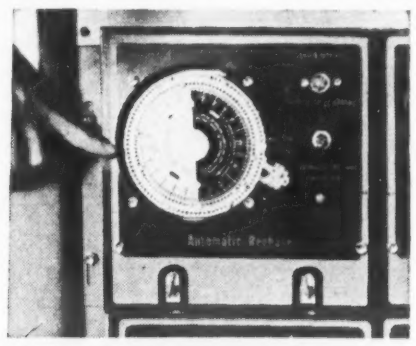
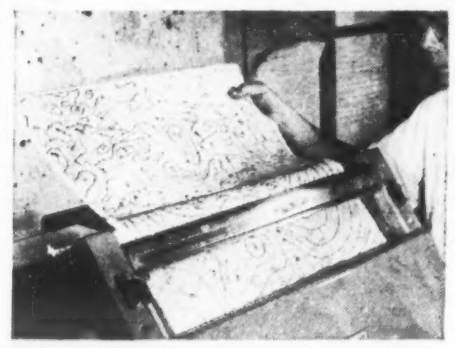


Time clock programming



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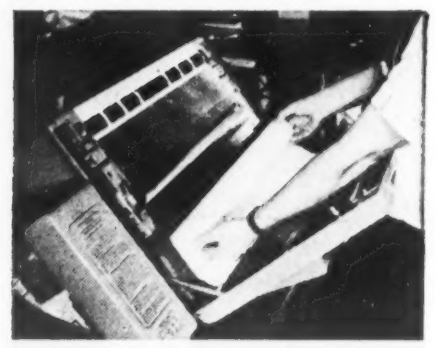

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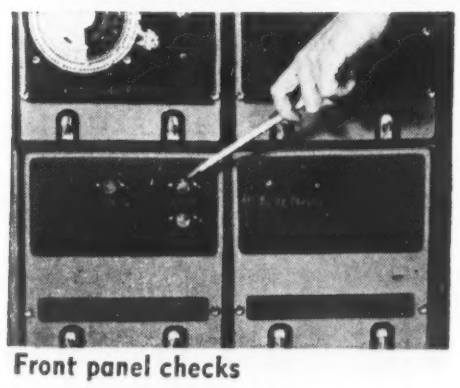

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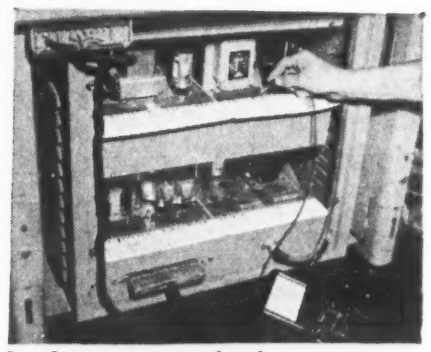
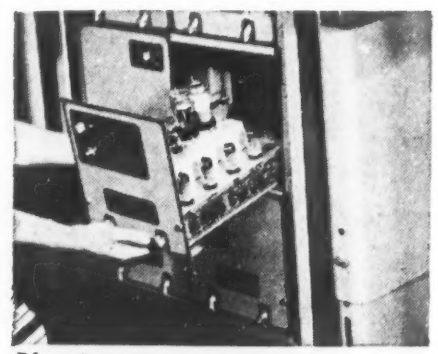


Back connector checks



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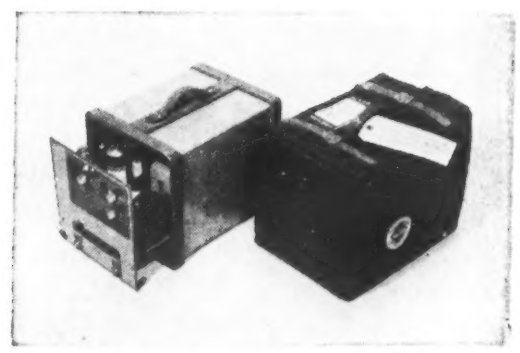

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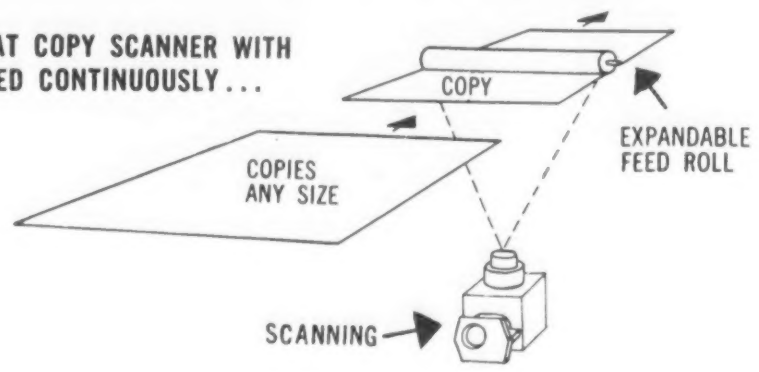

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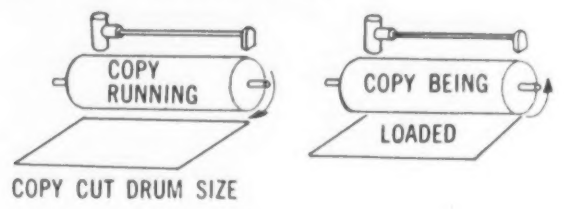

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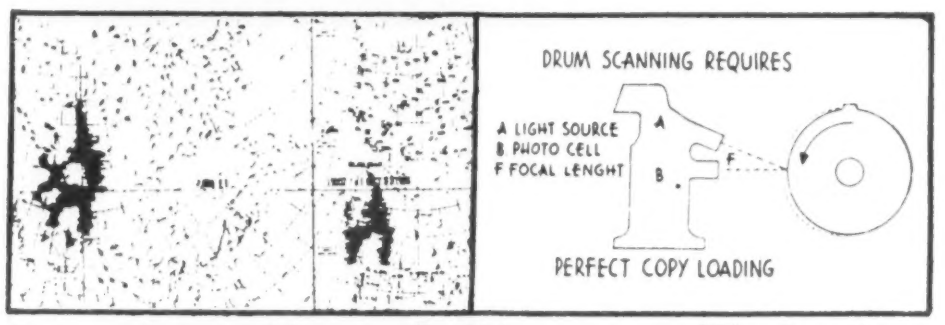
Flat Copy Scanner with expandable copy feed head takes maps any width or length — fed straight or kitty corner.

- **FOCUS SMUDGE ELIMINATED**



Focus smudge caused by unusually thick copy or copy lifting from drum

With copy feed rolls precisely positioning surface of map on flat copy scanner table, exact focal lengths are maintained for clear, sharp recordings.

- **MOST COMMENDED FEATURES**

  Personnel familiar with prior facsimile scanning techniques, lauding this new breakthrough in weather facsimile techniques, highly commend these features:

  - ease of copy handling
  - compactness and mobility of equipment
  - quietness and dependability of operation
  - cleanness and sharpness of copy produced

SEE FOR YOURSELF AT AFCEA—For convenience of air travelers at the 1960 Convention and Exhibit, an Alden Facsimile Recorder will bring continuous map transmissions from the High Altitude Network direct to the main lobby of the Sheraton-Park Hotel.

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Firm or Military Installation: .....

Title: ..... Type of Work: .....

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Type of Membership Desired:

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Subscription-Non-Member—$7.00 ☐ Foreign Mailing—$8.00 ☐

Enclosed find $ ..... for annual dues for AFCEA membership (or subscription) which includes the monthly magazine SIGNAL and Chapter Affiliation.

DATE: ..... SIGNATURE: .....

to provide the bare necessities for himself and his family. Technology developed through the partnership of science and industry enables him to accomplish so much more today that the 40-hour week is standard. Moreover, he has enough left over from his pay check after providing for food, clothing and shelter so that he and his family can enjoy their leisure time in travel, recreation and cultural pursuits.

The automobile, a product of the partnership we are discussing, permits the average American family to live in the pleasant surroundings of the country or the suburbs instead of under the shadow of the factory smokestack or the city skyscraper. People had to live close to their work before they were provided with modern means of transportation. The home itself is usually equipped with labor-saving conveniences such as mechanical refrigerators, automatic washers, power mowers and other devices which lighten the burdens of housewife as well as husband.

In virtually every other area which might be mentioned—such as health, diet or educational opportunities—the partnership of science and industry has made outstanding contributions. In health, for example, a recent survey showed that 90 per cent of the medical prescriptions are filled today with drugs which were unknown or unavailable before the Second World War. The discovery of an effective vaccine against poliomyelitis (plus the ability of pharmaceutical companies to produce this vaccine quickly, in huge quantities) within the last five years has made it possible to eliminate the dreaded scourge of one crippling disease. Hope for progress in treating other diseases now regarded as incurable is bolstered by the substantial rise in medical and pharmaceutical research just in the present decade.

Reformers, politicians and others frequently claim credit for the shorter work week and other social gains. While their contributions are considerable, it is nevertheless true that social gains are only made possible by abundance and abundance has never been created by law. All through history, social gains have been the result, rather than the cause, of national wealth and abundance.

End Part I

(Editor's Note: In Part II the author will speak more specifically about industrial forces in science which strengthen science and industry partnership in advancing human welfare.)

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for tomorrow's challenge
with ...

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Look for much that's new and exciting to happen in the communications systems field in the next five years . . . DDD for most of U.S. and Canada . . . CAMA for more and more large toll usage areas . . . line concentration . . . electronic switching . . . a rapidly expanding demand for private line services . . . and a great deal more advances requiring special design.

Despite satellites, the workhorse of systems communications will still be the same old cable pairs. But with alternate routing and VNL you'll regard them in a new light; and you'll take a more searching look at load coil spacings, net loss and return loss, while bias and sigma (old words with new meanings) will force you to correct trunks that don't meet minimum standards.

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Association affairs

AFCEA

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Washington 6, D. C.
Phone: EXecutive 3-3033

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1961

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1962

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John R. Howland*
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Donald C. Power

1963

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Brig. Gen. A. F. Cassevant, USA
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The President, the immediate Past President, the Vice Presidents and the Counsel are ex-officio members of the Board of Directors.
******Executive Committee Member.*

Moon Relay Messages at Show

The first public demonstration of the Communications Moon Relay system will take place at the opening of the AFCEA Convention at noon, May 24.

From a station set up in the foyer of the Sheraton-Park Hotel, Washington, D. C., messages will be sent to Hawaii via the moon and messages will be received at the hotel from Hawaii. The messages will be transmitted from the hotel to the Navy's Cheltenham, Maryland station, which in turn will send the messages to Hawaii.

Using the moon as a passive reflector, the CMR system offers reliable, high capacity, long distance communications limited only by the availability of the moon. The system was first tested before a selective group last February when messages were exchanged between Cheltenham and Hawaii. Each message was relayed a distance of about 480,000 miles in a matter of 2½ seconds. The demonstration at the Convention will take a very few seconds longer since the messages must be transmitted to the Cheltenham station before going to Hawaii.

Developmental Engineering Corporation of Washington, D. C., which developed the CMR system under a Bureau of Ships contract, will operate the hotel station.

Preceding the demonstration, introductory remarks will be made by Benjamin H. Oliver, Jr., AFCEA National President; W. J. Baird, AFCEA General Manager; Rear Admiral Frank Virden, Assistant Chief of Naval Operations, (Communications)/Director, Naval Communications and Lester H. Carr, President of Developmental Engineering Corporation.

Nominating Committee Appointed

AFCEA National President Benjamin H. Oliver, Jr., has appointed a five-man committee to prepare a slate of nominations for officers of the Association and members of the Board of Directors.

Nominations will be for the national president, the five vice presidents and eight directors. The national president and the five vice presidents will hold office for one year. The eight members of the Board of Directors will remain in office for the four-year period ending 1964.

Nominating committee chairman is Frank W. Wozencraft, General Counsel. Other members of the committee are Regional Vice Presidents W. K. Mosley, Walter H. Pagenkopf, Ray E. Meyers and Director Joseph R. Redman.

The committee will present its slate at the Executive Committee meeting in May, following which the members of the Council will act upon the recommendations of the nominating committee.

American Telephone & Telegraph Co., Long Lines Department

American Telephone & Telegraph Co., Long Lines Department, has become a sustaining member of AFCEA. The long distance operating unit of ATT, the Long Lines Department is the fifth sustaining member. AFCEA's sustaining membership was established in March 1959.

The Long Lines Department's thirty-five officials named as AFCEA representatives are: R. M. DeShon, Commercial Manager, Atlanta; W. E. Albert, District Plant Superintendent, Boston; O. L. Dodge, Division Plant Superintendent, Chicago; D. J. Loyd, District Plant Superintendent, Charlotte; H. A. White, General Manager, J. O. Rhodes, Defense Communications Manager, Cincinnati; A. W. Thompson, Assistant Defense Communications Manager, Colorado Springs; R. S. Brinson, Division Plant Superintendent, Denver.

Other representatives are: W. E. McNeely, Commercial Manager, Dallas; C. E. Greshner, Chief Testboardman, Dayton; W. B. Snell, District Plant Superintendent, Detroit; A. J. Esrey, General Manager, W. H. Massarend, Defense Communications Manager, Kansas City; J. P. Benson, Assistant Defense Communications Manager, Omaha; R. D. McCallum, Commercial Supervisor, Los Angeles; C. H. Miller, District Plant Superintendent, West Haven; C. F. Harp, Commercial Supervisor, New Orleans; C. E. Wideberg, White Plains.

Also included in the AFCEA membership are: H. T. Killingsworth, Vice President; C. E. Schooley, Director of Operations; F. R. Eckley, Director of Personnel; E. H. Crabb, Assistant Vice President; R. T. Dugan, Assistant Vice President; C. C. Duncan, Assistant Vice President; R. E. Gradle, General Manager; G. D. Montgomery, Executive Assistant; J. E. Heinrich, Overseas Staff Supervisor, New York; V. R. Hatch, Division Plant Superintendent, Wayne; W. S. Alderson, District Plant Superintendent, Pittsburgh; C. S. Wagner, Commercial Manager, San Francisco; E. F. Hagen, Division Plant Superintendent, St. Louis; J. C. Brunies, Assistant Defense Communications Manager, Belleville; R. R. Marsch, Commercial Supervisor, Seattle; M. F. Cook, Central Office Chief, Syracuse; R. B. Nichols, Government Communications Manager, Washington.

Associated Electrical Industries, Ltd.

Associated Electrical Industries Ltd. is a new group member. Located in London, the firm acquired British Thomson-Houston Co. Ltd. and Metropolitan-Vickers Electrical Co. Ltd. recently. British Thomson-Houston was a group member.

AFCEA representatives for the firm are: V. M. Roberts, Divisional Commercial Manager; A. L. Whiteley, Divisional Chief Engineer; W. S. Melville, Manager, Military Radar Engineering; E. S. Hall, Assistant Divisional Chief Engineer; E. A. Buckland, Manager, Military Radar Sales; R. S. Gilling, Factory Superintendent; G. S. C. Lucas, Director (Engineering); E. V. Small, Joint Managing Director; D. E. Burchett; T. S. Worthington.

Colonel Joseph A. Plihal, USAF, London chapter president, will present the group membership certificate to the company officials at a future chapter meeting.

The Martin Co.

The Martin Co., a manufacturer of missiles, rockets and electronic equipment, has joined AFCEA's growing group membership list.

Located in Baltimore, Md., the company has named the following men as AFCEA representatives: J. J. Slattery, General Manager, Electronics; G. J. Strickroth, Manager, Operations Planning; H. W. Royce, Manager, Marketing; R. H. Bair, Director, Electronic Manufacturing; G. H. Kunstadt, Manager, Ground Support Equipment; C. A. Carlsten, Operations Manager, Electronic Warfare; A. N. Shapiro, Sales Manager, Electronics; J. V. Sullivan, Sales Manager, Electronics; R. W. Cuthill, Director, Engineering; R. W. Kluge, Manager, Advanced Systems; R. M. Ringoen, Manager, Avionics Dept.; G. H. Teeter, Assistant Director, Engineering; J. M. Pearce, Director, Electronic Requirements; T. E. Thompson, Electrical Engineer.

The Martin Co. group membership certificate will be presented to the company officials at a future meeting of the Baltimore chapter. J. Walton Colvin, Baltimore chapter president, will make the presentation.

Ham Station at Convention

The Navy's Washington amateur radio station K4NAA will operate from the Sheraton-Park Hotel, Washington, D. C., during the 1960 AFCEA national convention.

AFCEA hams and all AFCEA members will be able to contact their homes or business offices during the convention via the ham station.

Specially designed QSL cards will be issued for the convention. K4NAA hours of operation will be 1000-2200 EST daily. Emphasis will be placed on the 10, 15 and 20-meter bands.

Chapter at Cape Canaveral

Cape Canaveral, Florida, the site of many missile launchings, is the location of AFCEA's forty-ninth chapter.

Officers of the chapter are president—H. N. Sturdivant, Radio Corporation of America; first vice president—Lt. Col. J. W. Kelly, USAF; second vice president—Dan Cusic, Southern Bell Telephone & Telegraph Co.; secretary—H. F. Blackwood, Radio Corporation of America; treasurer—Capt. C. W. Goldey, USA.

AFCEA National President Benjamin H. Oliver, Jr., presented the chapter charter at the chapter's first meeting last month.

T. J. Tully, RCA Service Co., was instrumental in getting the chapter organized. It was through his efforts that individuals interested in forming the chapter were brought together at a pre-organizational meeting of the chapter in March.

Cincinnati Chapter

The fiftieth AFCEA chapter, located at Cincinnati, Ohio, received its charter at the initial chapter meeting, April 26.

Details of the meeting will appear in next month's Chapter News.

Service Academy Awards

The four service academy awards, given yearly by AFCEA to the student in the graduating class who has the highest grade in the electronics course or an allied course, will be presented by AFCEA officials during June Week ceremonies. The awards will be transistor radios.

At the United States Military Academy on June 6, Benjamin H. Oliver, Jr., Vice President, New York Telephone Co., and AFCEA National President, will present the award to the cadet having the highest rating in electrical engineering.

The midshipman having the highest rating in electronics will be presented the award by Rear Admiral Frank Virden, USN, Assistant Chief of Naval Operations, (Communications) / Director, Naval Communications, and AFCEA First Vice President, at the United States Naval Academy on June 7.

The graduating cadet standing highest in electrical engineering at the United States Air Force Academy will receive the award from Major General Harold W. Grant, Director of Communications-Electronics, USAF, and AFCEA Second Vice President, on June 6.

The United States Coast Guard Academy student graduating with the highest rating in electronics will accept the award on June 7 from Glenn D. Montgomery, Defense Coordinator, Long Lines Department, American Telephone & Telegraph Co., and AFCEA Regional Vice President.

As we go to press SIGNAL *has learned that Republic Aviation Corp. and Melpar, Inc. have become AFCEA group members. Company listing will appear next month.*

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NO ADJUSTMENTS —
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THREE YEARS OF FIELD EXPERIENCE PROVE ABSOLUTE DEPENDABILITY!

INPUT: polar, neutral, either polarity, 15-100 mils. SSR-530-C actually corrects characteristic signal distortion, works perfectly on marginal signals!

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NEW MEMBERS

Listed below are new members of the AFCEA who have joined the Association during the month of March. Members are listed under the chapter with which they are affiliated. The April listing will appear in the June issue.

Atlanta
Lt. Col. Thomas H. Spencer

Augusta-Fort Gordon
SP-5 Carvin A. Phillips
Perry Sprawls, Jr.
Lt. Kenneth H. Campbell

Baltimore
Douglas G. Hern
Kenneth W. Smith, Sr.

Boston
K. A. Waldron
E. Victor Larson
Capt. William E. Albert
Jerome J. Weaver

Chicago
Lynn H. Miller
John P. Nielsen
Maurice Bank
James P. Carolan
John W. Baber
Rudy F. Binder
Melvin F. Skinner
Capt. Richard W. Andrews
J. J. Stults
Walter P. Czeropski, Jr.
Peter G. Bartlett
Francis R. Steel
C. H. Elder
Leon N. Skan

Dayton-Wright
George R. McCann, Jr.

Fort Monmouth
Robert F. Lewis
K. W. Olson
Alphonse J. Dalton
Lt. Comdr. Carl A. Jensen
M-Sgt. Frank W. Steimle
Leonard E. Evenson
Edward T. Flynn
Joseph Steinberg

Gulf Coast
Eugene H. MacMurray, Jr.
Joseph L. Jenkins
A-1C James W. Johnston
S-Sgt. John E. Kennedy
S-Sgt. Earl A. Sandelin
John F. Jackson
Anita M. Pfeiffer
Sarah B. Dorrough
James M. Homan, Jr.
William R. Nunnery
Karl J. Munch

Hawaii
1st Lt. T. G. Adcock
John R. Sanders

Kansas City
Hastings S. Key, Jr.

Lexington
Harold G. Flanery
Capt. Clayton J. Davis

London
Richard E. Hill
Frederick Holmes
1st Lt. Frederick L. Swedberg
Lt. Col. Lehman W. Rahn
Sydney G. Codling

Louisiana
Joseph T. Clements, Jr.
Alvin A. Brinker, Jr.
Edward J. Fousch, Jr.
Matt H. Creed
Mac Carmichael

Montgomery
William L. Hinds
Richard E. Powell
Winston R. Waters
Maj. Frank A. Wall
LCdr. John R. Joachim

New York
William Schenenga
John W. Stein
L. H. Decker
Gordon M. Nonnemacher
Donald R. Lewin
Charles Barbara
Sherwin B. Pomerantz
Henry J. Conwell
Harold Goldstein
Michael T. Gasparik
Lt. Leonard A. Curcio
Stephen Balter
Oscar H. Bauschinger
Robert S. Schoenfeld
Edward M. Hitchcock
William K. Lange
Stewart Nellis
James I. Carswell
Lt. Col. Richard F. Warren

Northeastern University
Robert A. Todisco
Fred C. Wynn
Richard P. Perkins
Fred T. O'Connell
George E. Lanctot, Jr.
Kenneth J. Knieser

North Texas
C. F. Faison
Arthur C. Davies

Northwest Florida
James W. Smith

Orange
Charles F. Bridge
Edward J. Tyzenhouse

Philadelphia
H. M. Gittelman
David I. Caplan
F. E. Rushlow
W. E. Conner
L. Cowles
M. Morton
B. V. O'Brien
R. E. Roberts
M. Arnold
D. T. Atkinson
G. Briney
E. H. Felix
Morris Harris

Rocky Mountain
John A. Hollansworth
Leonard M. Merritt
Robert A. Waller

Rome-Utica
William F. Frank
James P. Marshall
Robert E. Burns
William E. Johns
W. A. Kinnaman
B. L. Pfefer
J. L. Komer

San Diego
G. G. Linderman

San Francisco
C. G. Hiatt
John C. Schamburg
Cdr. Robert B. Harris
Cdr. Floyd E. Hudson
Capt. Harold A. Green
Capt. Albert L. Carlson
Harold E. Daniell

San Juan
Juan E. Viguie

Santa Barbara
Gordon S. Humphrey
Maj. Arthur T. Leger
Richard M. Schonkel
Charles D. Baer

Scott-St. Louis
V. Lee Tennant
Lt. Col. Frank M. Curtis, Jr.
Capt. Paul L. Brownlee
Harry H. Winken
Budd Reinhold
H. B. Groh

Seattle
Robert W. Calkins
Norris D. Pease
William O. Laande

Southern California
Harry L. Ogg
Edmund W. Baker
Bernard Berman
Forrest J. Bethel
Jules Kravetz
Ira C. Bechtold
Leroy Barrett
Harry Appleton
L. C. Parode
S. G. Lutz
H. A. Iams
A. E. Puckett
Robert Barton

Southern Connecticut
Nelson Gildersleeve

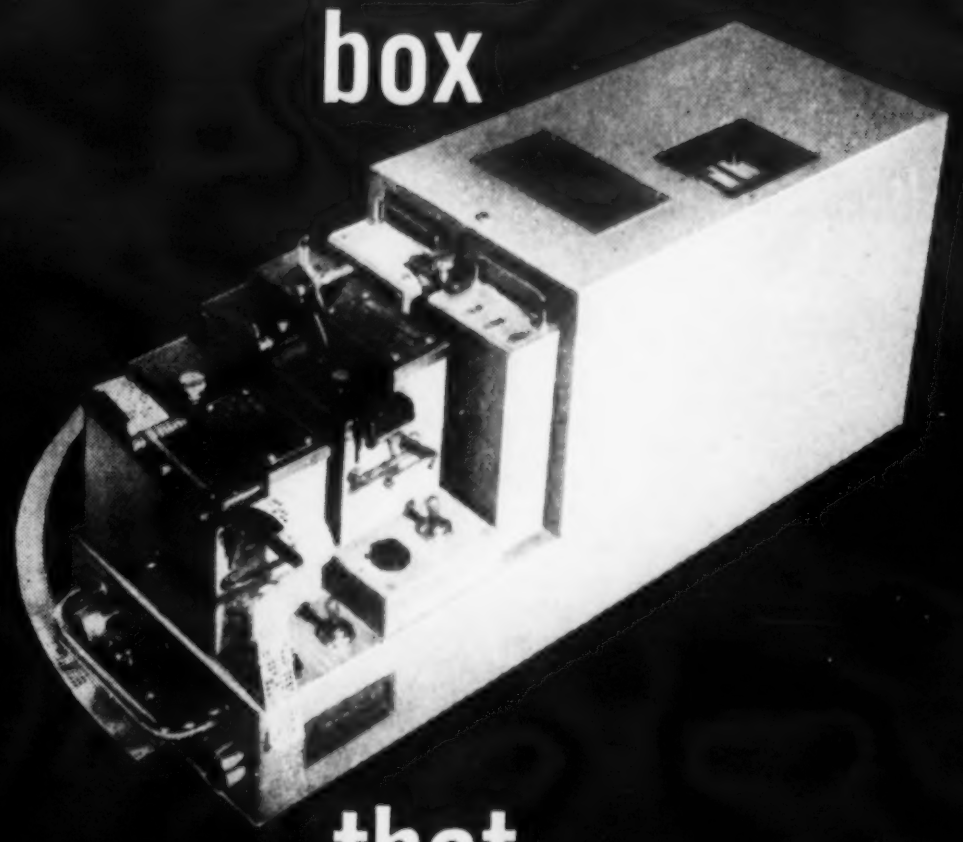
Syracuse
Eluin G. Berndt
George J. Stephan
R. David Grieh
Glenn E. Omholt
Gordon F. Denman
Paul L. Christensen
Edwin J. Graf
F. R. Prentice
C. E. Beard
H. Mease, Jr.
R. G. Henry
A. T. Schade

Tinker-Oklahoma City
Charles J. Cremeen

Washington
R. Marchese
John J. Kimball, Jr.
Fred S. Day
Arthur L. Winner
L. E. Saline
R. M. Vredenburg
K. N. Davis
Cmdr. Nils Dellgren
W. D. Roy, Jr.

Members at Large
Ing. Albino Antinori
Prof. Algeri Marino
Ing. Michele Maffei
Joseph W. Rooney
Ing. Federico Nicotera
Prof. Ivo Ranzi
Ing. Augusto Bigi
William C. Shaw, Jr.
C. E. Bold
D. E. Garr
M. R. Johnson
Robert K. Jones
Harold A. White
Dale E. Uhrig
Per-Olov E. Bergman
Paul E. Goley
Capt. Dean B. Vallery
John B. Miller

the little box



that speeds things up at the telegraph switching center

Its full name is the Telegraph Tape Reading and Auto-number Sending Unit. For short, TAA. It takes up only 6½″ x 22″ of bench space and is 9″ high. The associated electronic distributor fits a 19″ rack and is only 3½″ high x 8¼″ deep. It has two tape readers arranged to transmit messages automatically and alternately together with many special features (more than any comparable unit) which you'll see detailed in the panel on the right.

The TAA unit, developed and produced solely by the Automatic Telephone and Electric Co. Ltd., is not only sure of a great welcome at switching centers—it's also a real help in point-to-point work.

Ask A.T.E. for more information about TAA.

TAA gives you all these features

Automatically transmits: station call sign and serial number before message; start and end of message preambles when used in automatic switching networks; error signal and end of message preamble if an operator spots a mistake in the message; 100 character test message; routine message of 20 or 40 characters; station call sign and serial number at pre-determined intervals when there is no traffic. Switch selection of speeds 45.5, 50, 75, bauds and spare position for an optional speed. Choice of 7, 7½ or 8 unit code.

Stops and re-starts an interrupted transmission at any point without a new preamble. With tape, part of message can be repeated or omitted.

Transmits test message direct from the distributor.

Stands 59 & 60 at the AFCEA Convention

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AT 14031

AFCEA Sustaining and Group Members

Communications—Electronics—Photography

Listed below are the firms who are sustaining and group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

Sustaining Members

American Telephone & Telegraph Co., Long Lines Department
Cook Electric Co.
General Electric Co., Defense Electronics Div.
International Telephone & Telegraph Corp.
New York Telephone Co.

Group Members

Adler Electronics, Inc.
Admiral Corp.
Allied Control Co., Inc.
Allied Radio Corp.
American Cable & Radio Corp.
American Institute of Electrical Engineers
American Machine & Foundry Co.
American Radio Relay League
American Telephone & Telegraph Co.
Amphenol/Borg Electronics Corp.
Anaconda Wire & Cable Co.
Andrew Corp.
Arnold Engineering Co.
Associated Electrical Industries Ltd.
Atlas Film Corp.
Atlas Precision Products Co.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co., Ltd.
Autonetics, Division of North American Aviation, Inc.
Barry Controls, Inc.
Beiser Aviation Corp.
Bell Telephone Company of Pa.
Bell Telephone Laboratories, Inc.
Bendix Radio Division, Bendix Aviation Corp.
Bendix Systems Division, Bendix Aviation Corp.
Bliley Electric Co.
British Thomson-Houston Co., Ltd.
Bruno-New York Industries Corp.
Budd Lewyt Electronics, Inc.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co.
Cincinnati & Suburban Bell Tel. Co.
Collins Radio Co.
Columbia Broadcasting System, Inc.
Contraves Italiana
Convair, Division of General Dynamics Corp.
William C. Copp & Associates
Copperweld Steel Co.
Cornell-Dubilier Electric Corp.
A. C. Cossor Ltd.
Craig Systems, Inc.
Crosley Division-Avco Corp.
Decca Navigator Co. Ltd.
Designers For Industry, Inc.
Diamond State Telephone Co.
Dictaphone Corp.
DuKane Corp.
Du Mont, Allen B., Laboratories, Inc.
Eastman Kodak Co.
Electronic Associates, Inc.
Electronic Communications, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
General Analysis Corp.
General Aniline & Film Corp.
General Communication Co.
General Telephone & Electronics Corp.
Gilfillan Bros., Inc.
Gray Manufacturing Co.
Hallamore Electronics Co.
Hallicrafters Co., The
Haloid Xerox Inc.
Hazeltine Electronics Division, Hazeltine Corp.
Heinemann Electric Co.
Hoffman Electronics Corp., Military Products Div.
Hughes Aircraft Co.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co.
Indiana Steel & Wire Co.
Institute of Radio Engineers
Instruments for Industry, Inc.
International Business Machines
International Resistance Co.
Jansky & Bailey, Inc.
Jerrold Electronics Corp.
Kellogg Switchboard & Supply Co.
Kleinschmidt Laboratories, Inc.
Leich Sales Corp.
Lenkurt Electric Co.
Ling-Altec Electronics, Inc.
Litton Industries, Inc.
Lockheed Aircraft Corporation
Machlett Laboratories, Inc.
Magnavox Co.
Marconi's Wireless Telegraph Co. Ltd.
Martin Co., The
Materiel Telephonique Co.
McCoy Electronics Co.
Melpar, Inc.
Michigan Bell Telephone Co.
Montgomery Co., The
Motorola Inc.
Mountain States Telephone & Telegraph Co.
Mullard Ltd.
Muter Co., Rola & Jensen Divisions
Mycalex Corporation of America
National Co., Inc.
Nems-Clarke Co., Div. of Vitro Corp. of America
New England Tel. & Tel. Co.
New Jersey Bell Telephone Co.
North Electric Co.
Northwestern Bell Telephone Co.
Oak Manufacturing Co.
Ohio Bell Telephone Co.
O'Keefe & Merritt Co.
Pacific Telephone & Telegraph Co.
Packard-Bell Electronics Corp.
Page Communications Engineers, Inc.
Phelps Dodge Copper Products Corp.
Philco Corp.
Photographic Society of America
Plessey Co., Ltd.
Prodelin Inc.
Radiation, Inc.
Radio Corporation of America
Radio Corporation of America, Astro-Electronic Products Div.
Radio Corporation of America, Defense Electronic Products
RCA Great Britain, Ltd.
Radio Engineering Laboratories, Inc.
Radio Frequency Laboratories, Inc.
Ramo-Wooldridge, Division of Thompson Ramo Wooldridge Inc.
Raytheon Co.
Red Bank Division, Bendix Aviation Corp.
Reeves Instrument Corp.
Republic Aviation Corp.
Rixon Electronics, Inc.
Rocke International Corp.
Saxonburg Ceramics, Inc.
Scanner Corporation of America, Inc.
Servo Corporation of America
Singer Manufacturing Co., The Military Products Division
Smith-Corona Marchant Inc., Research and Development Division
Society of Motion Picture & Television Engineers
Southern Bell Telephone & Telegraph Co.
Southern New England Telephone Co.
Southwestern Bell Telephone Co.
Sperry Gyroscope Co., Division of Sperry Rand Corp.
Sprague Electric Co.
Stackpole Carbon Co.
Standard Electronics Co.
Standard Telephones & Cables, Ltd.
Stanford Research Institute
Stewart-Warner Corp.
Stromberg-Carlson Co., Division of General Dynamics Corp.
Surprenant Mfg. Co.
Sylvania Electric Products, Inc.
Technical Materiel Corp., The
Telectro Industries Corp.
Tele-Dynamics Div., American Bosch Arma Corp.
Telephonics Corp.
Teleprinter Corp.
Teletype Corp.
Texas Instruments Incorporated
T.M.C. (Canada) Ltd.
Tung-Sol Electric, Inc.
Union Carbide Corp.
United Telephone Co.
United Transformer Co.
Varian Associates
Webcor, Inc., Government Division
West Coast Telephone Co.
Western Electric Co., Inc.
Western Union Telegraph Co.
Westinghouse Electric Corp.
Westrex Corp.
Wheelock Signals, Inc.
Wilcox Electric Co., Inc.
Wisconsin Telephone Co.
Wollensak Optical Co.
Zenith Radio Corp.

COUNTERMEASURES and the myxine glutinosa

FORMIDABLE, INDEED, IS THE HORRENDOUS HAGFISH
though small in size, his capabilities are enormous...

Seventeen inches of devastating destruction are represented in the pictures above. Appearing to be no more than another small eel, this specimen can, in a matter of hours, eat his way through the skin of his victim and then proceed to devour everything except bone.

A small drone, equipped with devices to make it appear as one or more bombers when viewed on radar scopes, could very well carry an atomic warhead capable of delivering a devastating blow to a secondary target. Instruments For Industry has for many years perfec- e Army. ie fruits

COUNTERMEASURES and Instruments for Industry

The I.F.I. "Menagerie Series", familiar to most electrical engineers, graphically illustrates the contributions made by I.F.I. to this exacting field of countermeasure engineering upon which our very survival may well depend...

COUNTERMEASURES and the testudinidea malaclemys

FORTUNATE, INDEED, IS THE TURTLE
for he carries his countermeasure right on his back

Man on the other hand must devise his own countermeasures if he intends to survive in this day of modern warfare. Instruments For Industry is actively engaged in this field working in close conjunction with the Army, Navy, Marines and Air Force.

Recently developed is a portable unit w in effect, places a "ceiling of safety" personnel in the field making them a invulnerable to ballistic attack. I.F proud of this opportunity to contribu the defense of our services.

An I.F.I. "ceiling of safety" protects these men against surprise ballistic attack.

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Enlarged photos of the I.F.I. "menagerie" available on request to Dept. 201.

COUNTERMEASURES and the chamaeleon vulgaris

DECEPTION IS A FORM OF COUNTERMEASURE
and at this the chameleon must be considered an expert

The approach to the problem of survival through countermeasures has been neatly solved by this handsome little fellow. By simply changing his color to match the surroundings the chameleon may take on the appearance of a brown twig, a green leaf or so completely blend into the immediate area that his enemy is hopelessly confused. This, in effect, is countermeasure in the truest sense.

To confuse or mislead the enemy is often the problem faced by the military. Not to be outdone by the chameleon, electronic countermeasures have been developed which effectively confuse the presentations as seen on radar scopes. Defensive action is thereby delayed until too late. In this field, as well as many other forms of countermeasures, Instruments for Industry can apply exacting know-how and skill. The high degree of success achieved by IFI is proof of ability

Only one target is a true target. The big question... which one?

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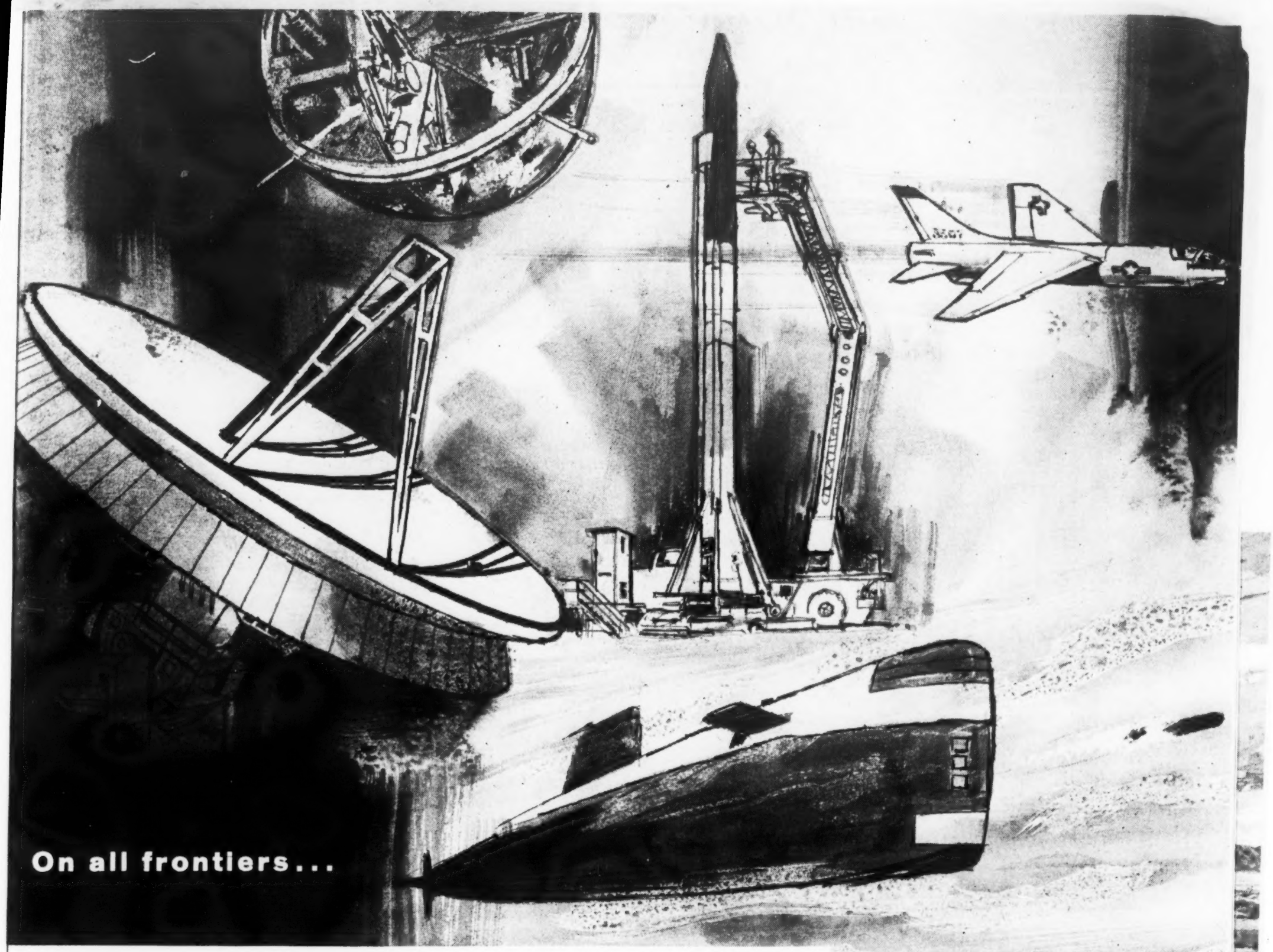

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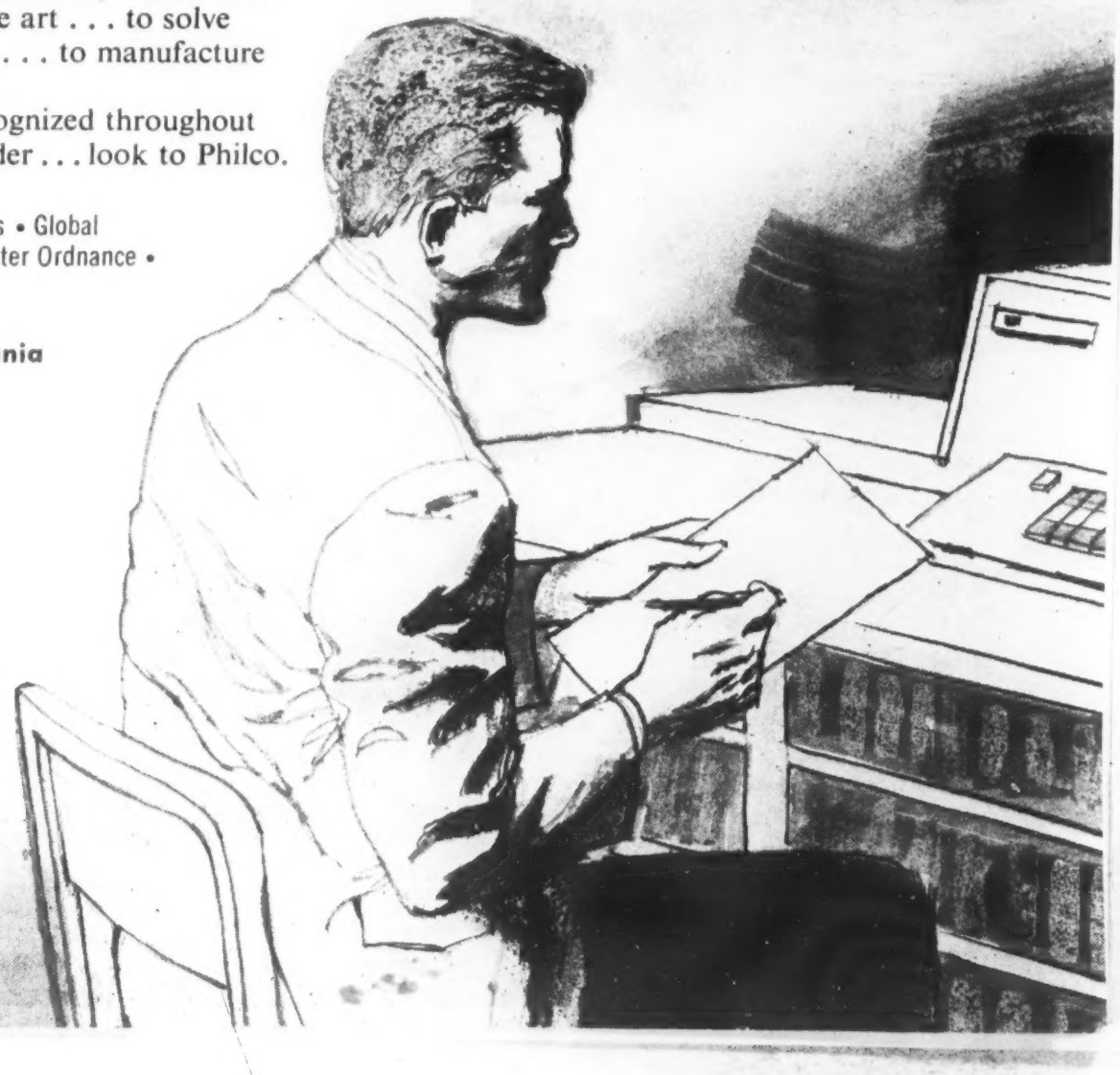

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Chapter News

Augusta-Fort Gordon

Color slides depicting life in foreign countries were viewed by members at the March 14 meeting held at Buck Lodge.

Baltimore

Rear Admiral Frank Virden, USN, Director, Naval Communications addressed the chapter's March 15 meeting.

Admiral Virden made several interesting comments about Navy communications: "Navy communications are interested in low and very low frequencies. Both of these can get through when high frequencies will be disrupted by unsatisfactory propagation conditions. Very low frequencies of about 15 kilocycles are particularly important because we can penetrate sea water with them."

Further in his talk the speaker noted, "Our interest in space communications extends farther than point-to-point moon relay communications. We look forward to equipping our ships some day for taking advantage of any available form of satellite or space communications."

Boston

Dr. Ivan Getting, Vice President of Engineering and Research, Raytheon Co., lead a discussion of "The Extremes of Radio Frequency Power in the Space Age" at the chapter's March 10 meeting held at Raytheon's headquarters in Waltham.

Dayton-Wright

An intensive membership drive was climaxed by a drawing at the chapter's April meeting.

Eligible for the awards were new members, or old ones who had been off the national records for a period of six months. The prizes ranged from a pen and pencil set to a solar powered transistor radio.

As an added inducement to participation of all current active members, awards were made to the top three active members who turned in the highest number of memberships during the drive. The first prize was a $50.00 savings bond, the second a $25.00 savings bond and the third prize was to be announced.

James T. Ramsey, Chairman of the Membership Committee, was in charge of the drive.

Fort Monmouth

James McMillion, color photography expert from the Ansco Co., Binghampton, New York, gave some practical tips to an audience of photography enthusiasts attending the chapter's March 16 dinner meeting at Gibbs Hall Officers Club.

Coordinator of Camera Club services for Ansco, Mr. McMillion showed over one hundred color slides. His own photographs have appeared in various national magazines and he holds several citations for his camera work.

Besides the AFCEA members, a delegation of the Monmouth Chapter of the Society of Photographic Scientists and Engineers were present for the talk.

Gulf Coast

John R. Bechtel, Field Engineer, Ampex Professional Products Co., explained in detail the video tape recording process to members attending the chapter's March 7 dinner meeting at the Airmen's Club, Keesler Air Force Base.

In giving a presentation of the video tape recording process, Mr. Bechtel explained the difficulties that were encountered before the system could be perfected. He also described techniques used in recording sound on magnetic tape and those used in recording television pictures on magnetic tape.

There were 106 members and guests present, including ten Canadian students from the Department of Global Communications Electronics System.

Lexington

The bi-monthly meeting of the Lexington Chapter was held on the evening of March 11. The guest speaker was Mr. William F. Cone, Ground Systems Group, Hughes Aircraft Company.

Mr. Cone discussed aspects of communications and showed color movies of Hughes Aircraft Company and the AN/MSQ-18, one of their new developments for the Signal Corps.

New York

The evolution of military communications from Civil War days to the present was discussed at the chapter's March 30 meeting at the Hotel Belmont Plaza.

Colonel William B. Feindel, Jr., Deputy Chief, Army Communications Systems Division, Office of the Chief Signal Officer, was the guest speaker. Colonel Feindel stated that there is a gap existing between military fire power and military mobility. He noted that communications have not kept pace with technology in the satellite and missile areas.

The speaker also discussed Project UNICOM, the universal integrated communications systems network and cited a need for industrial and military cooperation in the revolution of communications.

Northwest Florida

On March 18 the chapter met at the Officers' Club, Eglin Air Force Base, to hear Mr. T. J. Heckleman, Philco Corp., Philadelphia, speak on "System Design and Modernization of the Air Force World-Wide Communications Network."

Mr. Heckleman's talk covered the plans of the Philco Corp. to bring the Air Force World-Wide Communications Network up to the standards required by the present and future mission requirements of the Air Force. He summarized the methods Philco is implementing in order to consolidate and realign multiple communications networks of the Air Force into a unified system to assure flexibility, reliability, and speed of voice data, and message transmission. The modernization covers four major work areas: (1) Point-to-point single sideband circuits, (2) Air-ground single sideband circuits, (3) Intersite microwave radio links, and (4) Technical control facilities.

Mr. Heckleman explained these areas in detail. When the installation of the Air Communications Network is completed, the system will have a greatly increased traffic handling capacity, better system performance and higher reliability.

Election of officers for the 1960-61 year was also held at this meeting. The following officers were elected: President—Maj. Ray Kinslow, Air Proving Ground Center, Eglin AFB, Florida-Directorate of Communications; 1st Vice President—Capt. Joseph Rigali, 4756th Air Defense Wing, Base Communications Officer, Tyndall AFB, Florida; 2nd Vice President—Mr. James W. Smith, Southern Bell Telephone Co., Pensacola, Manager, Commercial Sales; Secretary—Capt. Roy L. Stover, 4751st ABRON, ADC, Eglin AF Aux. Fld. #9, Base Communications Officer.

Following the election of officers, Mr. Sam Love, outgoing chapter president, was given a special vote of thanks for his fine leadership of the chapter during the past year.

San Diego

The March meeting of the chapter was held in the San Diego County Civil Defense Headquarters at Gillespie Airport, Santee, California.

The program was devoted to Citizens Radio with emphasis on the more recently authorized 27 megacycle band. John Crews, Inspector in charge of the Federal Communications Commission in San Diego, described the laws and licensing pertinent for Class D Citizens Radio. Many chapter members already have or contemplate having such facilities for both personal business and pleasure trips afield. The Heath Kit single channel with regenerative receiver in the lowest cost bracket and the Globe 3-channel version with superheterodyne receiver and squelch provisions in the medium-high cost bracket were displayed and studied by the audience. Several other versions were also briefly mentioned that are adequate for such use.

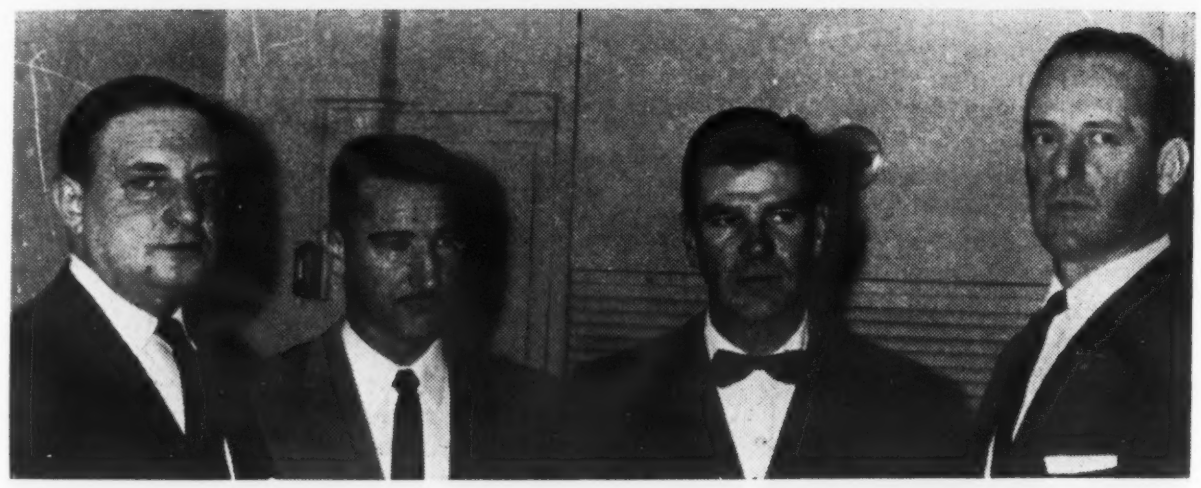
The San Diego Chapter voted to

(*Continued on page* 104)

Augusta-Ft. Gordon—*Members of the Augusta-Fort Gordon chapter take time from a recent meeting at Buck Lodge to pose for the photographer.*

Boston—*Guest speakers at the chapter's March meeting, Harry Letaw, Manager of System Marketing, and William C. Brown, Associate Director of Engineering, Microwave and Power Tube Division, Raytheon Co., explain the operational system of an amplitron tube, to ranking military guests. Shown L to R are: Col. Sidney S. Davis, chapter president; Letaw; Brown; Gen. Robert Hackett, Commanding General, 56th Artillery Brigade, Air Defense, Ft. Banks.*

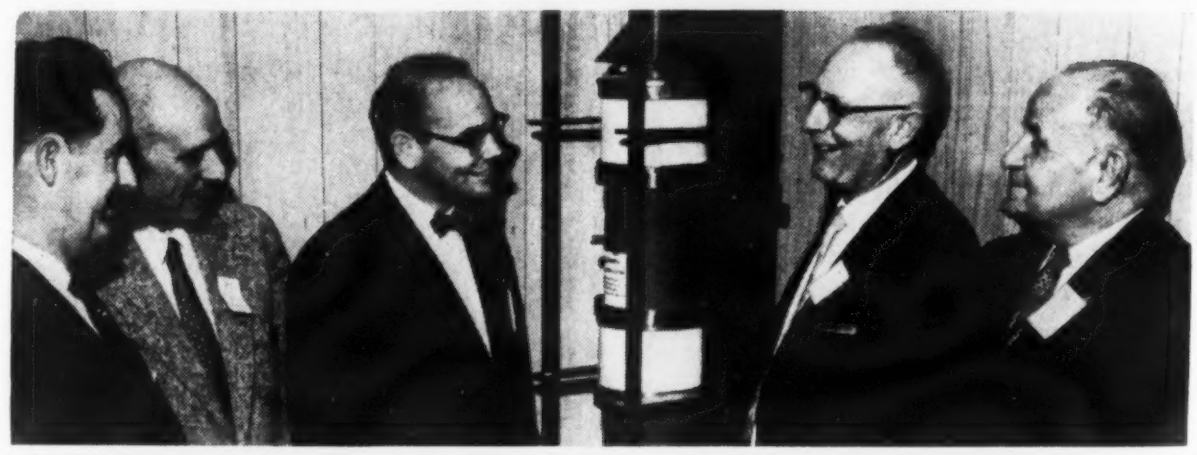
Fort Monmouth—*Shown at the March meeting are L to R: Maj. Gen. J. O. Mauborgne, USA (Ret.); J. Mangiaracina, President, Society of Photographic Scientists and Engineers; Norman Freeman, chapter president; James McMillion, guest speaker; Harry C. Ross, chapter secretary; Col. John Walters, Deputy Commander, U. S. Army Signal Research and Development Laboratory.*



Montgomery—*Gathered at the chapter's meeting are L to R: Lt. Col. Herbert Herman, USAF, chapter president; Capt. Bruce E. Bailey, USAF, guest speaker; Dr. Paul H. Nesbitt, Director of Information Center, Research Studies Institute, Air University; Col. Vincent J. Donahue, Commander, Office of Special Investigations, South Eastern District, Maxwell Air Force Base.*

Northeastern University—*At the chapter's meeting are shown L to R: Charles French, guest speaker; Capt. Roy M. Rich, assistant faculty advisor; Allen Short, student chapter president.*

Northwest Florida — At the chapter's meeting are L to R: Sam Love, retiring chapter president; Maj. Ray Kinslow, USAF, newly elected chapter president; T. J. Heckleman, guest speaker.



San Francisco—Pictured L to R at the chapter's meeting are: Elmo Simmons, chapter secretary; H. C. Holcombe, Pacific Tel. & Tel. Co.; Hap Bailey, Manager for Government Marketing at Eitel-McCullough; L. H. Schnoor, chapter president; J. F. Parachini, chapter treasurer.

Scott-St. Louis — The five individuals shown at the chapter's meeting are L to R: John W. Baber, Cook Electric Co.; Maj. Gen. D. C. Doubleday, USAF, Commander, AACS, Scott Air Force Base; Robert J. Dennis, guest speaker; Harry N. Lindquist, Cook Electric Co.; Col. George A. Zahn, USAF, chapter president.

change from monthly meetings to five meetings a year.

San Francisco

Eitel-McCullough, Inc., was host to chapter members for the March meeting. After a dinner in the company's cafeteria, members were conducted on a tour of the facilities at the new San Carlos plant. Members were given the opportunity to see all phases of the manufacture of various types of electron tubes produced by "Eimac."

Scott-St. Louis

The March meeting of the chapter was held in Belleville, Ill. Proposed candidates for the April election of officers were presented to chapter members. Guest speaker for the evening was Robert J. Dennis of Cook Electric Company, Chicago. Mr. Dennis who is Chief Liaison Engineer of the company's Technological Center Division discussed the *Dilemma of the Defense Contractor in Advance Planning.*

Mr. Dennis pointed out that advance planning for military defense work is in a sense the counterpart of market research in industrial organizations and that the dilemma arises in three major areas: Recognizing a problem area far enough in advance; Formulating an approach or solution to the problem; and, Getting the Military to provide the necessary funding for the program.

The highlight of Mr. Dennis' talk was the showing of a new film on Parachute Recovery Systems that have been developed over the last decade by the Cook Electric Co. This film, produced by the Cinefonics Group at the Cook Technological Center, opened with reentry of a glowing nose cone, trailed by burning debris of the disintegrating rocket. The film illustrated the research that had to be done with rocket sleds and free-fall missiles before the first vehicles had ever been sent into outer space and successfully recovered with these systems.

Seattle

Special guest at the chapter's January meeting was Mr. Francis D. Reynolds, senior group engineer for the Boeing Airplane Co. Mr. Reynolds is in charge of electronic assignments in the IXM-99 Bomarc Missile Project.

Mr. Reynolds provided a comprehensive description of the theory of flight and the constructional features of the Bomarc missile. His description was illustrated with a scale model Bomarc missile. A film was shown illustrating the launching, control and maneuverability of the missile.

Tinker-Oklahoma City

The chapter's February meeting was held at the Tinker Air Force Base Officers Mess.

Alvin Turner, Demonstration Engineer for the Southwestern Bell Telephone Co., spoke on electronic systems which provide a new type telephone service and are the nerves of today's guided missiles. Using special equipment, Turner demonstrated a small electronic brain which seemed to be capable of reading the human mind. Turner explained a new numbering system around which these machines function.

A model of the present Nike Hercules, the guided supersonic antiaircraft missile was displayed. The Nike Zeus, an anti-missile missile now under development in the Bell Laboratories was also described. The Titan ICBM model was displayed and its communications system for homing-in on enemy targets explained. Chapter members were also presented with a model of the satellite Vanguard I.

Sylvania Electric Products Co., Shawnee, Oklahoma, was host to the chapter for their March meeting. Members were conducted on a tour through the plant and observed the manufacture of small radio receiving tubes.

APRIL PROCEEDINGS FOCUSES ON

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In this important special issue are articles on propulsion, navigation and guidance, communication, tracking and surveillance, telemetry and instrumentation and measurements. There are over 50 of these studies, each one contributing to the radio-engineers' interest in space — for performing new scientific experiments, global communications and space travel.

This Space Electronics issue is another in the many services offered members of the IRE. Non-members of the Institute of Radio Engineers, however, are invited to reserve a copy of this vital report by returning the coupon below, today.

PARTIAL CONTENTS OF THIS APRIL SPACE ELECTRONICS ISSUE:

"The NASA Space Science Program"

"A Comparison of Chemical and Electric Propulsion Systems for Interplanetary Travel," by C. Salzer, R. T. Craig and C. W. Fetheroff

"Photon Propelled Space Vehicles," by D. C. Hock, F. N. McMillan, and A. R. Tanguay, Radiation, Inc.

"Interplanetary Navigation," by G. M. Clemence, USN Observatory

"Navigation Using Signals from High Altitude Satellites," by A. B. Moody, USN Hydrographic Office

"Inertial Guidance Limitations Imposed by Fluctuation in Gyroscopes," by G. C. Newton, Jr., MIT

"Propagation and Communications Problems in Space," by J. H. Vogelman, Dynamic Electronics-New York, Inc.

"Communication Satellites," by D. L. Jacoby, U. S. Army Signal Research & Development Lab.

"Interference and Channel Allocation Problems Associated with Orbiting Satellite Communication Relays," by F. E. Bond, C. R. Cahn and H. F. Meyer, Ramo-Wooldridge

"Solar Batteries," by A. I. Daniel, USASRDL

"Extra-Terrestrial Radio Tracking and Communication," by M. H. Brockman, H. R. Buchanan, R. L. Choate and L. R. Malling, NASA-California Institute of Tech.

"Tracking and Display of Earth Satellites," by F. F. Slack and A. A. Sandberg, AF Cambridge Research Center

"Interplanetary Telemetering," by R. H. Dimond, Radiation, Inc.

"The Telemetry and Communication Problem of Re-Entrant Space Vehicles," by E. F. Dirsa, Admiral Corp.

"Radiation and Instrumentation Electronics for the Pioneer III and IV Space Probes," by C. Josias, California Institute of Technology

"Applications of Doppler Measurements to Problems in Relativity, Space Probe Tracking and Geodesy," by R. R. Newton, The Johns Hopkins University

"High Speed Electrometers for Rocket and Satellite Experiments," by J. Praglin and W. A. Nichols, Keithley Instruments, Inc.

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All IRE members will receive this April issue as usual. Extra copies to members, $1.25 each (only one to a member).

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NEWS ITEMS AND NEW PRODUCTS

Several organizations are requesting that papers to be considered for presentation at meetings scheduled for 1960 be submitted by the following dates.

The 9th Annual Industrial Electronics Symposium, jointly sponsored by The Institute of Radio Engineers Professional Group on Industrial Electronics and the AIEE, to be held in Cleveland, Ohio, on September 21 and 22—submit titles and abstracts to Mr. G. E. Hindley, Chairman Paper Procurement Committee, Reliance Electric and Engineering Co., 24701 Euclid Avenue, Cleveland 17, by July 1, 1960. Prospective authors are requested to submit papers relating to the main theme of the Symposium — industrial applications of electronics stressing application and use of new products and ideas rather than basic research. Sub themes would embrace such as the following: gauging and measuring, material handling, process control, process techniques and data handling.

The 4th Global Communications Symposium, co-sponsored by IRE Professional Group on Communications Systems and the U. S. Army Signal Corps in honor of its 100th Anniversary, to be held August 1, 2, and 3 in Washington, D. C.—submit abstracts to Mr. Ralph L. Clark, c/o Office of Director of Research and Engineering, Washington 25, D. C., by May 16.

The 7th East Coast Conference on Aeronautical and Navigational Electronics sponsored by the Baltimore Section, IRE and the Professional Group on Aeronautical and Navigational Electronics, scheduled for October 24, 25 and 26 in Baltimore—submit 500-word abstracts of papers for unclassified sessions, together with brief professional record of the author to Mr. Sanford Hershfield, Mail No. G-3143, The Martin Co., Baltimore 3, Md., by June 6. This conference will emphasize technical developments, techniques and accomplishments associated with aeronautical and navigational electronics. Unclassified papers are requested related to aircraft, missiles and space vehicles. Fields of interest include air traffic control, navigation, communications, ground support equipment and so forth. Papers are also requested in such specialties as computers, radar, microwaves, antennas and propagation and integrated electronic devices. No exhibits are planned so that those attending can devote themselves completely to technical sessions. The East Coast Conference Award of $100 will be presented to the author of the best paper. A second prize of $50 will also be awarded. In order to qualify for the awards, the complete paper must be received by September 1. Papers received as abstracts only, or received after September 1 will not be eligible for award and will not be considered for publication in the Proceedings of the conference.

The 11th National Conference of the Professional Group on Vehicular Communications, IRE, to be held in Philadelphia on December 1 and 2—submit abstract of 500 words to W. G. Chaney, A.T.&T. Co., Rm. 1710, 195 Broadway, New York 7, N. Y., by July 15; authors will be notified by August 15 of their acceptance. Papers on subjects covering the vehicular systems and equipment designs are invited. Discussions on new or unusual system techniques, applications of new types of components or related circuitry, interference reduction or bandwidth utilization are also invited. Emphasis on field proven subjects is desired. Manufacturers and users are urged to take advantage of the opportunity to share experiences in this field. Topics covered may include land vehicular, personal signaling, VHF maritime and air-ground communications.

• • •

During the next few months Air Research and Development Command (ARDC) officers will visit major U.S. cities to acquaint scientists and industries with current ARDC projects and interests. The program is known officially as Project CATE (*C*urrent *A*RDC *T*echnical *E*fforts).

Part of the program includes the preparation of an index of nearly 50,000 scientists and engineers to permit quick access to experts in any particular phase of technology. Individual rosters will be prepared for 33 different technical areas. Among these are materials, electronics, biosciences, research, communications, nuclear warfare, propulsion and geophysics.

When completed, the rosters will be distributed to industry scientists and engineers who register with CATE and will be revised quarterly.

Air Force contractors and subcontractors have been asked to have their engineers and scientists fill out cards listing their primary field of interest and other information required for the index. A second and more complete roster will list all registered engineers and scientists in both industry and Air Force and their specialties. The second roster will be distributed only to Air Force engineers and scientists.

• • •

President Eisenhower on March 17 sent a message to the Congress stressing the need for substantially expanding U. S. exports. This message launched a program which several executive departments have designed to strengthen the Government's trade development services. The program calls for significant improvements in the assistance offered to the business community through the American Foreign Service and through the Department of Commerce and its field offices in the U. S.

Under Secretary of Commerce, Philip A. Ray, Chairman, Interagency Export Promotion Task Force made the following remarks at a Press Conference on March 17, "The President's message initiates new action by the Executive Branch—in a series of coordinated measures to improve and expand government services to private industry in the development of world trade and to enlist increasing cooperation between government and business in finding new markets overseas.

"We expect the program will stimulate more production, more sales, more jobs and more impetus to economic growth. Our exports also should help raise the level of living of our foreign customers.

"Characteristics of the program include high priority in government policy henceforth to be given to export expansion—a higher plateau of interest and activity by respective government agencies—and a broader participation in export promotion by private enterprise on a sustained basis.

"Government can assist—and will assist more than ever—but, in the last analysis, business itself must make and sell the goods."

Recommendations of the Interagency Task Force were accepted by

Executive Branch agencies and are the basis for the National Export Expansion Program announced by President Eisenhower. Details of this program will be presented during the Congressional hearings to be held on the expansion of U. S. trade and in connection with a forthcoming request for the supplemental appropriations necessary for rapid progress in the export program.

• • •

The Moore School of Electrical Engineering of the University of Pennsylvania has announced a special summer session on recent developments in the field of electrical engineering. Three two-week programs will be given during the period June 20 through July 16, 1960. Titles of the programs are as follows: Modern Radar Techniques, New Devices in Amplifying and Switching, and Numerical Analysis for Digital Computation.

The aim of the session is to provide a coordinated presentation of developments of the past 5 to 10 years in these technical fields and thus to help bring engineers, scientists and technical administrators abreast of new and prospective electronic techniques in fields closely related to their own.

Instruction will be intensive; participants will attend class 6 hours a day, 5 days a week. The teaching staff is being assembled from the forward ranks of industry. Prerequisite for enrollment is a bachelor's degree or its equivalent in engineering, mathematics or science. Enrollment charge is $250 per program; an institutional rate of $125 is available to educators. For further details write to Special Summer Session Office, The Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia 4.

• • •

An advanced high-speed oscilloscope was shown at the annual IRE Show by the Boston firm of Edgerton, Germeshausen & Grier, Inc. The scope, Model 707 and 708 in the Milli-Mike line can detect and display phenomena lasting only 20 billionths of a second. It is a traveling wave deflection-type oscilloscope designed to display both single transient and repetitive phenomena in the millimicrosecond and sub-milli-microsecond regions.

The Model 707 and 708 Milli-Mike oscilloscope has an extremely high frequency response. The bandwidth is rated as DC to 2000 megacycles, usable to 3000 megacycles. Rise time is 0.2 millimicroseconds. For greater flexibility, two different signals can be applied at the same time. Six calibrated sweep speeds are available for operation ranging from 5 millimicroseconds to 3000 millimicroseconds in the unmagnified condition. The display area may be varied from 1 x 1.5 cm at 30 KV to approximately 3 times this size at 3 KV permitting more information to be contained in the unmagnified display than is normally found in a conventional 5-inch KRT oscilloscope.

Two metal ribbon helices with a characteristic impedance of 100 ohms comprise the upper and lower vertical deflection structure in the TW cathode ray tube. The signal is applied directly to the input of one or both helices by means of a transmission line. No signal amplification is used thus bandwidth limitation, noise generation and signal distortion are minimized.

• • •

New military-type silicon power rectifiers are now in production at the Semiconductor Products plant of Bendix Aviation Corporation's Red Bank Division. The 1N1614, 1N1615 and 1N1616 have been designed to meet military specifications MIL-E-1/1240, 1/1241 and 1/1242 respectively.

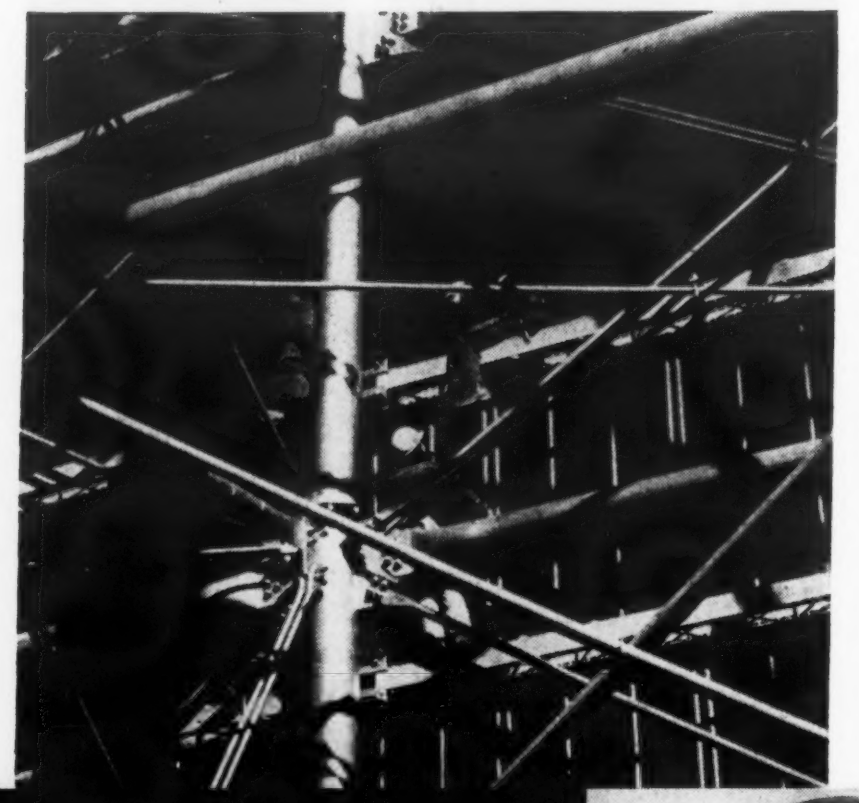
The new rectifiers feature a high reverse voltage characteristic ranging from 200 to 600 Vdc and will operate at high temperatures with the low reverse current of one milliampere at 150°C. The rectifiers are characterized by low forward voltage drop of 1.5 Vdc at 10 Adc.

• • •

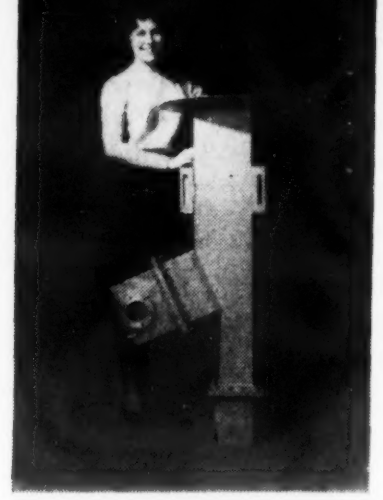
Stanford Research Institute engineers have designed a device which successfully eliminates radio static caused when aircraft fly through snow or clouds of ice particles. The device allows noise-producing corona discharges to occur but prevents the generated noise from reaching the radio antennas.

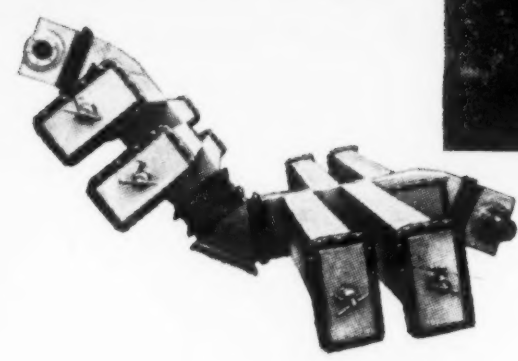
When ice crystals composing the snow or clouds rebound from aircraft, electrons are removed from them and remain on the surface. Each impact leaves a minute negative charge. The cumulative effect of millions of such impacts is to cause the aircraft to become quickly charged to a voltage so high that corona discharges occur at the wing tips and other sharp extremities.

The corona discharges occur as a series of short-lived pulses, each of which acts as a tiny, broad band radio transmitter. The waves generated by the pulses travel about the aircraft, guided by the metallic surfaces, and enter the radio antennas. The result in the receiver is known



Beyond the Black Boxes...





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as precipitation static. This noise is frequently severe enough to impair seriously the functioning of radio receivers and navigation equipment.

To prevent the airplane from becoming charged when flying through solid-particle precipitation is impossible. It is also impossible to prevent the noise producing corona discharges from occurring. The SRI-developed devices incorporate a sharp tungsten pin supported by a resistively coated plastic cement for attachment at all points on the aircraft at which the discharges occur.

A typical discharge device consists of a nylon rod about the size of a lead pencil, with the tungsten pin crosswise through it at a very carefully determined location (about an inch) from the outer end. The nylon rod is coated with paint having the proper electrical resistance.

The static discharges are also effective in carrying off charge created by jet-engine exhausts. While the static from this source is generally less than from precipitation, it is particularly troublesome because it is worse during the throttle changes that occur during landing—when good radio communication is particularly critical.

This basic problem of precipitation static has been under study by SRI for the Air Force. A study of application of this static-elimination measure on military aircraft is being made.

• • •

General Instrument Corporation's Thermoelectric Division at Newark, N. J. has developed a small (one-foot high), lightweight (10 pounds) thermoelectric generator that reportedly can produce electricity for a year on $10 worth of ordinary propane gas and will keep running as long as the fuel supply lasts. General Instrument has placed the generator on the market.

Surrounding the burner is a metal combustion chamber which captures the heat. Attached to each of the four sides of the combustion chamber are the thermopiles. The heat not used by the thermopiles is conducted directly to heat rejection fins made of aluminum, which form the outer shell of the whole unit and give it a star-like appearance. The generator produces 5 watts of power.

• • •

An advisory service organization, Washington Associates, has been formed to provide a source of advice and assistance to industrial clients in ascertaining where a particular company can best direct its activities in meeting requirements of government agencies. The organization was founded by John C. Ten Eyck and Gordon L. Caswell of Ten Eyck Associates, Inc., Washington, D. C. Although affiliated with Ten Eyck Associates, Washington Associates does not engage in any sales representation—it is a complementary service to the parent organization.

The Association is composed of men whose assembled experience and capabilities qualify them to offer the maximum in mature, government-industry relationships. Washington Associates is located at 1624 Eye Street, N.W., Washington 6, D. C.

• • •

Telectrovision, a new system for viewing televised images transmitted automatically and inexpensively over telephone wires was displayed at the IRE Show by Telectro Industries Corp. of Long Island City.

According to Harry Sussman, Telectro president, "Live scenes or written data can be transmitted over ordinary telephone lines without any limitation of distance, thus removing the need for costly coaxial cables. A company using this equipment can tie in with any other user of the equipment by dialing in," he said. "In addition, and equally important, the pic-

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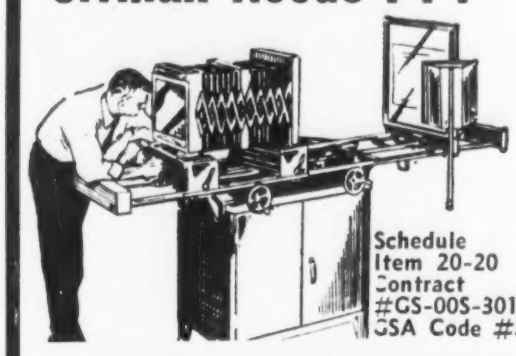

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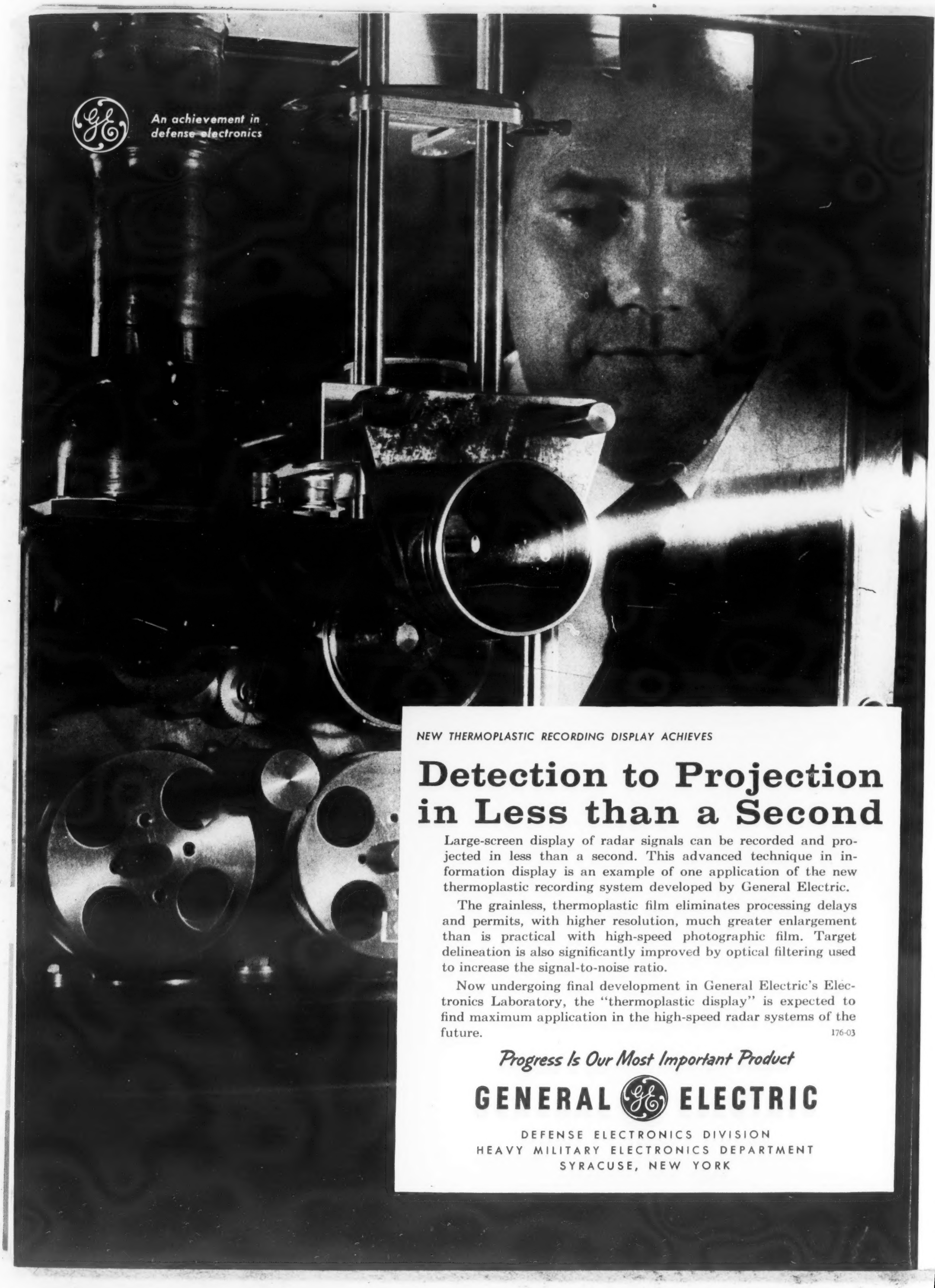

NEW THERMOPLASTIC RECORDING DISPLAY ACHIEVES

Detection to Projection in Less than a Second

Large-screen display of radar signals can be recorded and projected in less than a second. This advanced technique in information display is an example of one application of the new thermoplastic recording system developed by General Electric.

The grainless, thermoplastic film eliminates processing delays and permits, with higher resolution, much greater enlargement than is practical with high-speed photographic film. Target delineation is also significantly improved by optical filtering used to increase the signal-to-noise ratio.

Now undergoing final development in General Electric's Electronics Laboratory, the "thermoplastic display" is expected to find maximum application in the high-speed radar systems of the future. 176-03

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ture can be stored in an electronic tube and viewed upon demand through the pushing of a button."

The company plans to deliver its first Telectrovision units shortly to the Air Force for use in the giant weather radar data communications system now being installed.

• • •

Atlantic Research Corporation of Alexandria, Virginia, uses a plastisol technique to convert a mud-like slurry of vinyl resin, plasticizers, aluminum powder and ammonium perchlorate into a powerful, extremely reliable solid fuel propellant.

Atlantic has worked on the plastisol technique a number of years. The technique was developed initially by Union Carbide Corporation for the production of vinyl raincoats during World War II and has since become an important industrial process, particularly in the coating of metals.

A plastisol is a dispersion of vinyl resin particles in a plasticiser. Heated to the proper temperature (about 350°F.) it fuses into a rubbery tough material. As a binder and fuel in the missile, it locks the various components into a homogenous mass with a long service life. The unplasticized mixture stores well. Atlantic has been able to develop rocket fuels for temperature extremes ranging from minus 80°F. to plus 250°F. by modifying the ingredients. The aluminum powder added to the mixture gives the rocket a sharp boost in power.

The plastisol method of solid fuel preparation offers many advantages. The fuel mass may be easily shaped and sized for a particular rocket application. It is a fast, economical processing method, allowing a large through-put in a relatively small plant. In the words of Atlantic Research, "the method permits substitution of additives, high-energy ingredients, binder compositions and oxidizers to serve different rocket requirements without significantly influencing the other properties of the basic propellant." The burning rate may be changed by a factor of ten by modifying the burning rate additive.

• • •

A cathode ray bulb with 35,000 separate wire conductors embedded in a face plate only 3 by ¼ inches in size has been developed for high-speed electronic printing. The new process is capable of printing 20,000 characters a second. It also can be used to transmit by microwave or wire systems facsimiles of graphic and printed materials.

Corning Glass Works of New York produces the vacuum-tight bulb with wire-embedded face plate for use in the Videograph process developed by the A. B. Dick Company. Bulb design was a cooperative effort by Corning and Sylvania Electric Products, Inc. Sylvania processes the finished tube.

Each conductor in the rectangular matrix of the face plate is .001 of an inch in diameter. Nominal space between conductors is .003 of an inch. These conductors serve to transfer an electrostatic charge from an electron beam to moving paper. The information can be obtained from a computer or from magnetic tape. The videograph, according to the A. B. Dick Co., prints the information as fast as it can be fed to the equipment.

• • •

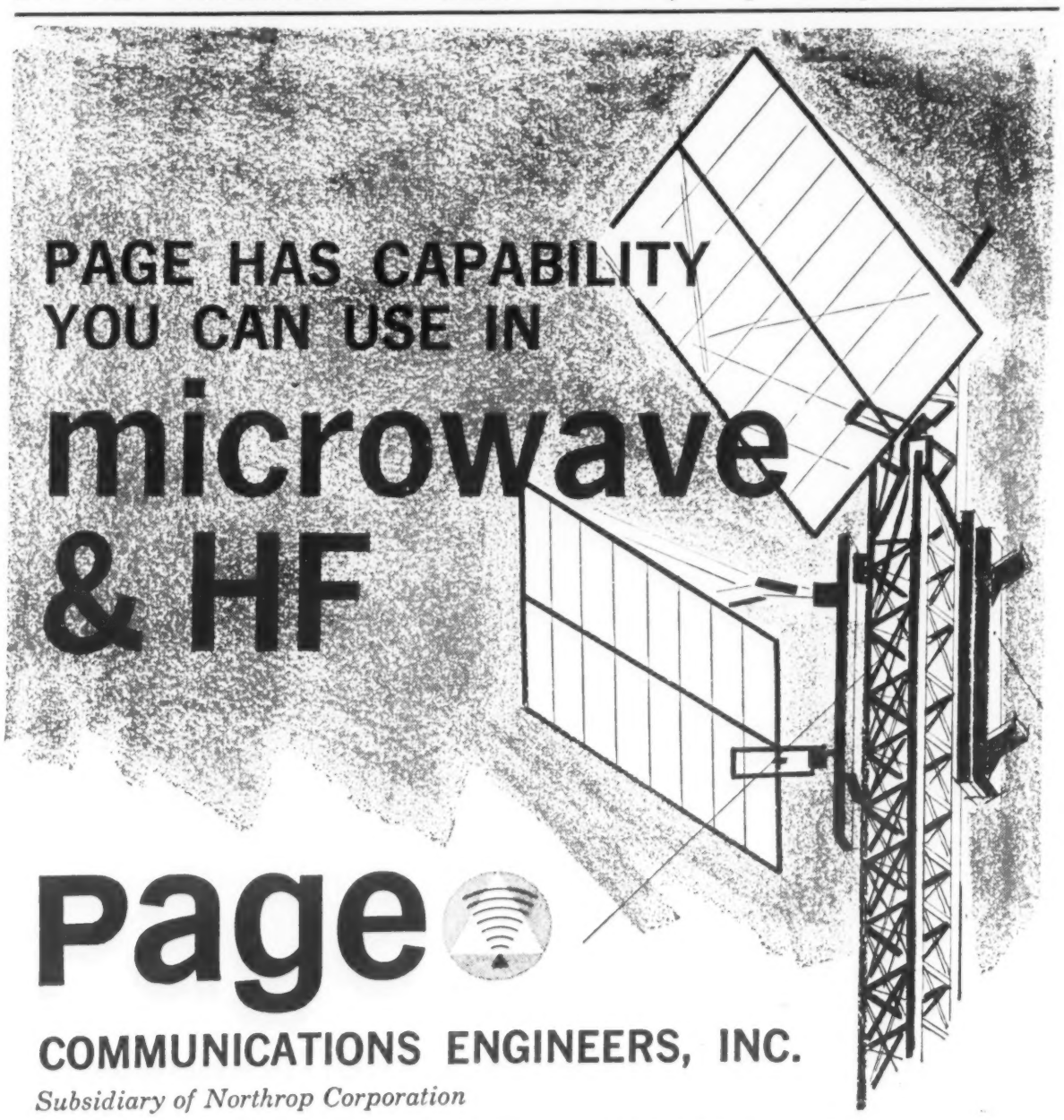
The General Plate Products group of Texas Instruments Incorporated, Metals & Controls division has announced the development of a process to coat carbon directly onto steel. Preliminary studies using experimental electron tube anode material made by the new process suggest that the material will have high emissivity and power dissipation with low gas content.

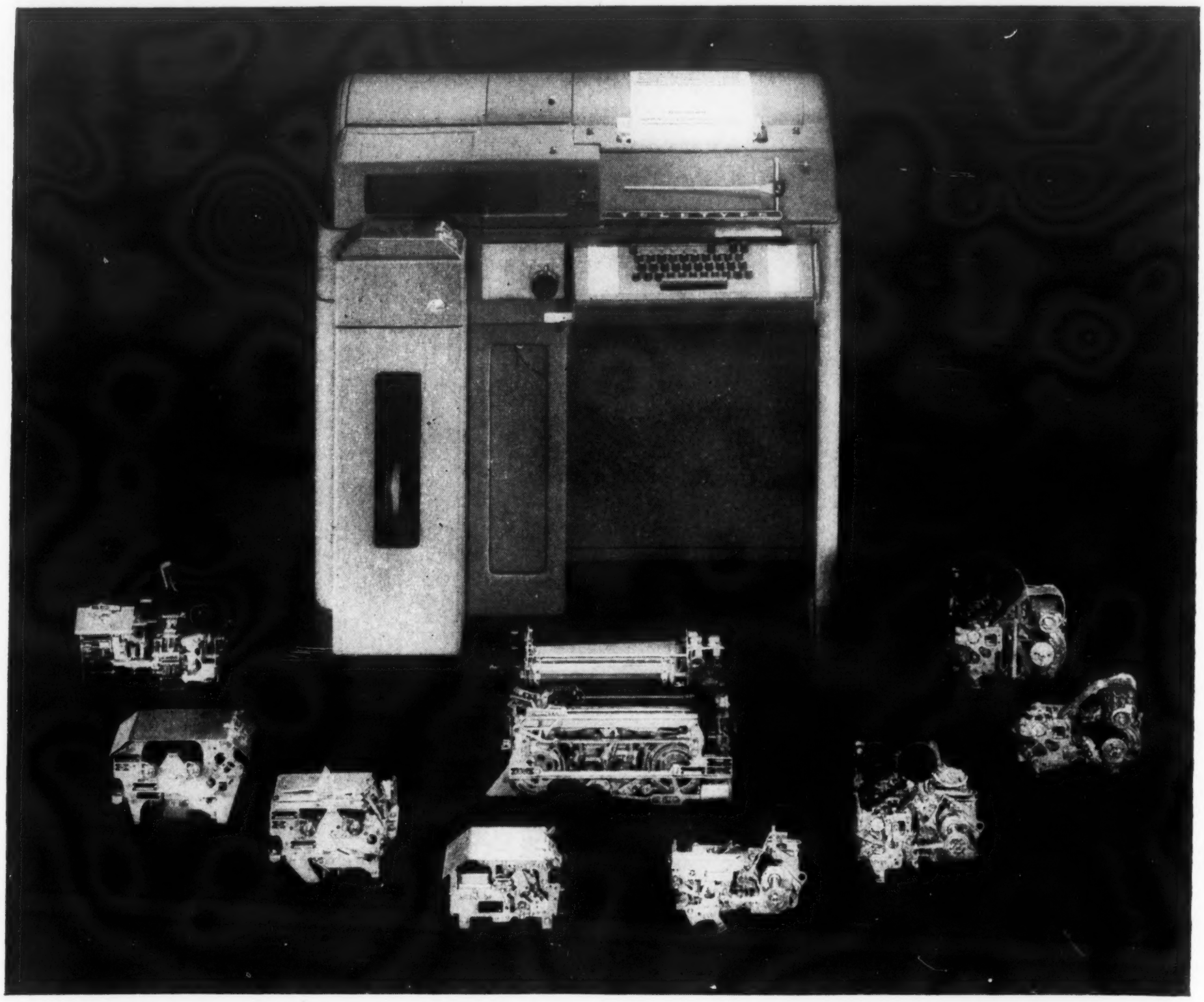
Carbon-coated steel sample material is now under evaluation by electron tube manufacturers in actual tube applications. Findings from earlier tests conducted by Texas Instruments indicate that the new anode material has an emissivity comparable to gas carbonized nickel-clad steel with one-half to one-third the gas content. The material was fired and formed in tests without any carbon flaking. Power dissipation is similar to the widely-used ALIRON(R) anode clad metal. Density is twice that of gas carbonized materials.

• • •

"The pheonomenal rate of progress in the development of new weapons, resulting in fast obsolescence of current equipment, poses a real problem in our effort to stretch the defense dollar," Brigadier General Elmer L. Littell recently told a symposium of the Electronic Industries Association in Washington, D. C. General Littell, Commanding General of the U. S. Army Signal Supply Agency, was the Army's representative on the panel of the Defense Market Planning Seminar, with the theme, "More Defense per Dollar Through Planning."

Pointing out that the Army operates the largest supply system in the world and manages a bulk stock inventory of approximately $20 billion, General Littell emphasized the necessity for providing logistical sup-





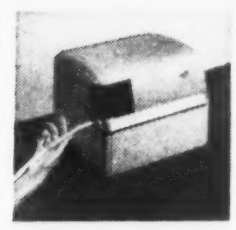
Complete Message Center in one Teletype Machine

A complete message center in a compact cabinet, with a choice of components to best meet your individual needs—that's the story of the Teletype Model 28 automatic send-receive set.

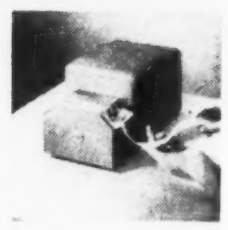
It provides facilities for sending and receiving on message paper or sprocket-fed business forms. In addition, there is a choice of four different tape reader and four different tape punch components—for preparing punched tape and for sending and receiving with tape.

The flexibility of the set is further broadened by a built-in control unit, the "stunt box," which may be equipped for a wide variety of extra features and switching duties—eliminating the need for external apparatus often required for such functions.

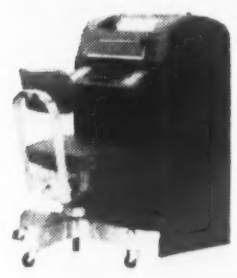
The ASR set is a compact, efficient tool to speed communications and cut costly paperwork. Why not investigate what it can do for you?



Typing Tape Punch



Tape Reader



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port to our national defense effort. "We cannot accomplish this goal alone," he declared. "In order to achieve our objectives, we must increase our planning and coordination with industry."

In outlining the Army's management of its over-all electronics program, he pointed out that the aim of its planning is to obtain the greatest possible return from the taxpayer's dollar investment. to the end that the Army's equipment will be both modern and effective in combat.

About 85% of the communications-electronic end items and components used by the Army are planned and managed by the U. S. Army Signal Corps, which is celebrating its 100th birthday this year. General Littell estimated that the field Army of the 60's will be equipped with upwards of 75,000 Army-operated electronic emitters—about 2½ times the number in use at the end of World War II.

General Littell suggested "Requirements" as the basis of any defense planning program. in establishing the targets for defense planning. Other items to be considered for sound defense planning are the resources of the military. industrial. scientific and educational team. the need for realistic evaluation of resources and requirements; the reciprocal obligation or action of defense and industry planners to share skills and plans with each other; and the ability to respond quickly to change and accept it as an inevitable component of progress.

• • •

The Air Force MARS Western Technical Net has announced the following schedule for May:

May 8: "Steps in Space," by John Herrick. Staff Member. Tech. Training & Scientific Relations Group, Space Technology Labs., Inc.

May 15: "Operations Alert 1960 of OCDM," by Messrs. Post. Zimmerman and Bower, Staff Members. OCDM.

May 22: "The Challenge of Inertial Guidance." by T. A. Fuhrman. Staff Member, Space Technology Labs.. Inc.

May 29: "Technical Net Session," by USAF MARS Technical Net Members.

The net can be heard each Sunday afternoon from 2 to 4 PM PDST on 7832.5 kcs and 143.46 mcs.

Photoprogress

Meteorologists are enthusiastic over the possibilities of new help for weather problems from America's new weather eye in space, TIROS I. Earlier pinpointing of tropical storms, more accurate flying-weather forecasts and more data for better long-range forecasting are some of the benefits weather experts hope to gain from the National Aeronautics and Space Administration's satellite.

TIROS is an acronym for *T*elevision *I*nfra-*R*ed *O*bservation *S*atellite. TIROS I does not have the infra-red sensors to map relative temperatures of the earth's surface, but a later one will have these sensors. The satellite weighs 270 pounds and circles the earth about every 90 minutes at an altitude averaging 450 miles. TIROS is shaped like a round pillbox, is 42 inches in diameter and 19 inches high. It is spin-stabilized in space, like a gyroscope, so that its bottom surface only faces the earth during part of its orbit. Electrical power for the satellite is provided by banks of solar cells. or sun batteries. They operate directly when the vehicle is in the sun and also charge lightweight storage batteries for power when it is in the earth's shadow. The system to direct the satellite into its circular orbit is the same radio-inertial command guidance system developed by Bell Telephone Laboratories and Western Electric Co. for the Air Force Ballistic Missile Division for use in the first squadrons of the Titan ICBM.

Two television cameras to photograph the earth's changing cloud cover patterns are mounted in the satellite. Both provide meteorologists with detailed pictures of hurricanes and cyclone patterns. The wide-angle camera, at 400 miles altitude, is designed to cover an area of cloud cover roughly 800 miles on a side. The narrow-angle camera will photograph a smaller area located within a wide-angle camera's view. The narrow angle camera pictures cover 80 miles on a side. Alike except for lens equipment, the cameras are both the size of a water glass and use a ½-inch Vidicon tube especially designed for satellite use. Each camera consists of two parts: a Vidicon and a focal plane shutter which permits still pictures to be stored on the tube screen. An electron beam converts this stored picture into a TV-type electronic signal which can be transmitted to ground receivers.

Lens speed of the cameras are: wide angle—f/1.5, narrow angle—f/1.8; shutter speed: 1.5 millisec; lines per frame: 500; frames per second ½; video bandwidth: 62.5 kc. The information gathered by the cameras in individual photographs is stored on

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magnetic tape in the satellite and then fed, on radio command, to ground stations. There are two basic ground stations, one at Fort Monmouth, N. J., operated by the Army Signal Corps and the other at Keana Point, Hawaii. operated by Lockheed Missile and Space Division and its consultant, Philco Corp., under contract to the Air Force Ballistic Missile Division. Back-up stations are at Highstown, N. J. and Cape Canaveral, Florida. These stations can order photographs three orbits in advance, when the satellite's position and the sun combine for the best picture possibilities. Ground stations can take their own pictures. When the satellite is in range, it can be commanded to transmit the TV picture of the moment directly to earth, without being taped.

Cloud cover pictures are recorded at both basic ground stations on film and magnetic tape. Original films are transmitted at once to Washington for analysis ,while duplicates and the tapes, which can be converted to photos, are processed at the sites.

The entire satellite system was developed under the technical supervision of the U. S. Army Signal Research and Development Laboratory, Fort Monmouth by the Astro-Electronic Products Division of RCA at Princeton, N. J.

Names in the News

Francis H. Lanahan, chairman of the board, International Electric Corp. and an AFCEA Director, has been named a member of the U. S. Army Signal Corps Centennial Advisory Committee. The committee will plan and direct the 100th anniversary of the Army Signal Corps, which will take place next month.

Robert O. Vaughan has been appointed vice president, marketing at Southwestern Industrial Electronics Co., a division of Dresser Industries, Inc. Mr. Vaughan formerly was western regional manager of government operations for Dresser Industries.

R. A. Irwin has been appointed director of space activities for Westinghouse Electric Corp. In this newly established position, Mr. Irwin will be responsible for coordinating the firm's capabilities within the space industry.

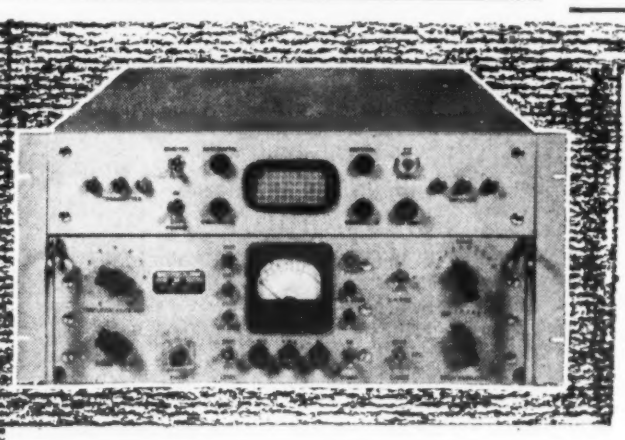
Richard M. Hultberg has been appointed director of the Systems Development Division-Melbourne at Radiation Inc. Prior to joining Radiation, Mr. Hultberg was with International Telephone and Telegraph Corp. for ten years where he served as manager of the Electronic Products Division of ITT's Kellogg Division.

Lawrence Mendelsohn has been promoted to director of Instruments Department in the Military Products Division of Hoffman Electronics Corp. Since coming to Hoffman in 1957, Mr. Mendelsohn has been a vice president and has headed the electromechanical function which now is broadened to the Instruments Department.

John R. Halligan has been promoted to vice president and secretary at The Hallicrafters Co. and **Edward Bishop, Jr.** has been named treasurer of the Chicago firm. Mr. Halligan previously was treasurer and assistant to the president, while Mr. Bishop served as controller.

Glen P. Bieging has joined Packard Bell Electronics Corp. as vice president, marketing, of the company's new Defense and Industrial Group. For the last five years he has been associated with General Electric Co.

General David M. Shoup, Commandant, United States Marine Corps, has accepted AFCEA's invitation to become an honorary member of the Association during his tour of duty. The certificate was presented to General Shoup, Apr. 6.



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a wire line terminal unit for transmitting and receiving binary information at 600/1200/2400 (bits/sec) in a nominal 3-kc voice band, such as a long-distance toll circuit. The SEBIT-24 finds use in transmitting message data for 3000 words per minute teleprinters; high speed data between business machines and computers; slow scan TV or facsimile information; time division multiplex information; and sequential transmitting of telemetering data.

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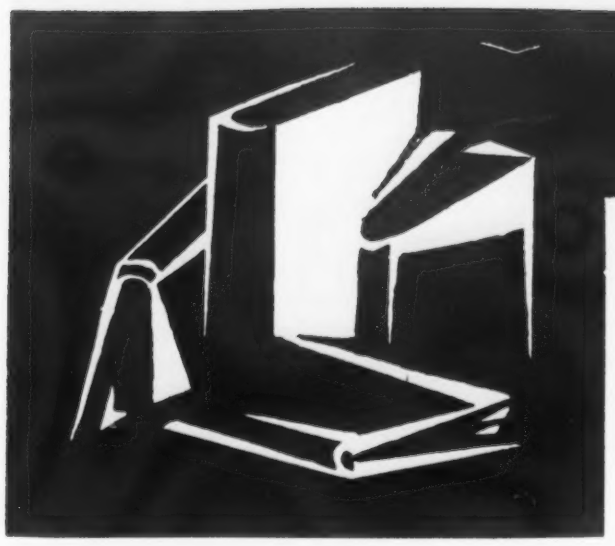

Books

INTRODUCTION TO MATRIX ANALYSIS, by Richard Bellman. McGraw-Hill Book Co., Inc., N.Y.C. 1960. 331 pages, $10.00.

Three basic fields in the analysis of matrices are clearly covered in this book—symmetric matrices and quadratic forms, matrices and differential equations, and positive matrices and their use in probability theory and mathematical economics. Also presented is part of the theoretical treatment of the use of matrices in the computational solution of ordinary and partial differential equations by means of digital computers.

Each section includes discussions of the mathematical, physical and economic backgrounds of the matrix theory introduced. Important chapters are included on dynamic programming and stochastic matrices. A large number of references to original papers containing further results are also given.

Emphasizing the parts of matrix theory that occur in analysis and applications, the contents of this book are specifically slanted toward the needs of analysts, statisticians, mathematicians, mathematical physicists, engineers, and mathematical economists.

The author, Richard Bellman, is a mathematician with The RAND Corp., and has been a professor of mathematics at Princeton and Stanford Universities.

DICTIONARY OF ATOMIC TERMINOLOGY—English-German-French-Italian, edited by Lore Lettenmeyer. Philosophical Library, Inc., N.Y.C., 1959. 298 pages, $6.00.

This dictionary provides a selection of the essential scientific and technical terms employed in connection with atomic and nuclear physics, reactor engineering, radiation physics and associated fields, with the object of facilitating the study of the relevant foreign literature on the subject.

The English expressions are arranged alphabetically; following the English come the German, French and Italian sections, with equivalent numbers. A comprehensive index makes it possible to locate any term easily and swiftly.

THE KRONSTADT REBELLION, by Emanuel Pollack. Philosophical Library, Inc., N.Y.C., 1959. 98 pages, $3.00.

The book is a description of the first and only organized armed revolt against the Soviets which could have led to a Third Revolution in Russia. The rebellion which was led by sailors and officers of two Baltic fleet ships, leaders of the Kronstadt Red Army units, and heads of the local Soviet was suppressed.

The author is on the faculty of the School of Philosophy and Liberal Arts at the New School for Social Research in New York City and director of Russian language broadcasts for Radio Station WHOM, New York.

SPACE FLIGHT, Volume I—Environment and Celestial Mechanics, by Krafft A. Ehricke. D. Van Nostrand Co., Inc., Princeton, N. J., 1960. 513 pages, $14.50.

The subject of Space Flight is to be covered in a three volume work by Krafft Ehricke. These works are part of a series entitled *Principles of Guided Missile Design* edited by Grayson Merrill, General Manager, Astrionics Div., Fairchild Engine and Airplane Corp. Merrill describes the purpose of the series as, ". . . to give a basis for instruction to university students, scientists, engineers and technical officers of the Armed Services so that they can become well grounded in the technology of guided missiles and space flight."

Part one of the first volume of *Space Flight* covers the concept of space flight and the environment in which it will take place, to the extent that we know at this time, with emphasis on the gaps in our present knowledge which require space research by means of rocket vehicles. The historical development of the space flight concept is traced and utility aspects showing the important correlation between utility and evolution of space flight discussed.

The second part is devoted to celestial mechanics, presented for the first time from the viewpoint of the astronautical scientist rather than the astronomer. Central force field, orbit determination and perturbation analysis are successively covered. Central force field theory is treated in general as well as with respect to its specific conics and includes a comprehensive collection of formulae for time-saving computational work. In orbit determination, the orbital elements are derived and coordinate systems and their transformation, units of time, aspects and methods of orbit determination are covered. The discussion of perturbation theory includes the various types of perturbation, three body problems and in detail, the various methods of special perturbation analysis.

THE NAVY BLUE BOOK, Volume I, edited by Tom Compere. Military Publishing Institute, Inc., N. Y., 1960. 374 pages, $1.50.

The purpose of this book is to bring about a better understanding of the U. S. Navy by its own personnel, as well as by the public. The book contains 38 interesting articles on naval affairs and accomplishments. A comprehensive section on Navy facts should prove valuable as a reference. The up-to-date facts cover Navy organization, bureaus, ships, fleets, aircraft, weapons and history.

Hard cover copies are available at $4.95 each from the Bobbs-Merrill Co., Inc. of Indianapolis, Indiana.

FROM CEDAR MOUNTAIN TO ANTIETAM, by General Edward J. Stackpole. The Stackpole Co., Harrisburg, Pa., 1959. 466 pages, $5.95.

In the summer of 1862 Lincoln sought victory by constituting the Army of Virginia in the Warrenton area, under Maj. Gen. John Pope, to threaten Lee from that direction while McClellan continued to press against Richmond on the James River. But the Confederates defeated Pope in detail, first at Cedar Mountain then on a larger scale at Second Manassas (Bull Run). Following a dramatic aftermath at Chantilly, Lee invaded the North, with Harrisburg as his initial objective. McCellan, preempting command of the combined Federal forces, followed Lee to Frederick, and from there over the western mountain passes where two battles were fought. Meantime Jackson circled around to capture Harpers Ferry, after which he rejoined Lee on the Antietam where the bloodiest single day of the war was fought. The fight ended in a stalemate, after which Lee retreated into Virginia.

The author, in addition to clarifying the flow of events, gives in his analysis the reasons for what happened, and brings into sharp relief the main characters of the drama.

Personnel & Positions Available

As a service to AFCEA members, SIGNAL will make space available in this column for those members who are interested in employment in the communications, electronics and photography industries. Any member is entitled to three insertions in the magazine on a space available basis, free of charge. Please limit your notice to 5 lines. In replying, employers are asked to address: Box ——, SIGNAL, 1624 Eye St., N.W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.

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COMMUNICATIONS ENGINEER with twelve years' knowledge of Japanese governmental and industrial communications desires position in Japan. Fluent Japanese, MS Business Administration. Capable sales and engineering-administrative management. Box 158.

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